Cat. No. W399-E1-1

SYSMAC

CPM2B-S001M-DRT

Programmable Controller

OPERATION MANUAL

OMRON

SYSMAC CPM2B-S001M-DRT Programmable Controller

Operation Manual

Produced May 2001

Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to property.

⚠DANGER Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠WARNING Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠Caution Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury, or property damage.

OMRON Product References

All OMRON products are capitalized in this manual. The words “Unit” and “Board” are also capitalized when they refer to an OMRON product, regardless of whether or not they appear in the proper name of the product.

The abbreviation “Ch,” which appears in some displays and on some OMRON products, often means “word” and is abbreviated “Wd” in documentation in this sense.

The abbreviation “PC” means Programmable Controller and is not used as an abbreviation for anything else.

Visual Aids

The following headings appear in the left column of the manual to help you locate different types of information.

Note Indicates information of particular interest for efficient and convenient operation of the product.

1,2,3... 1. Indicates lists of one sort or another, such as procedures, checklists, etc.

© OMRON, 2001

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form, or by any means, mechanical, electronic, photocopying, recording, or otherwise, without the prior written permission of OMRON.

No patent liability is assumed with respect to the use of the information contained herein. Moreover, because OMRON is constantly striving to improve its high-quality products, the information contained in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual. Nevertheless, OMRON assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication.

TABLE OF CONTENTS

PRECAUTIONS ..... **xi**

1 Intended Audience xii
2 General Precautions xii
3 Safety Precautions xii
4 Operating Environment Precautions xiii
5 Application Precautions xiv

SECTION 1
Introduction **1**

1-1 CPM2B-S Features and Functions 2
1-2 System Configurations 8
1-3 Structure and Operation 14

SECTION 2
Board Specifications and Components **21**

2-1 Specifications 22
2-2 Board Components and their Functions 28

SECTION 3
Installation and Wiring **33**

3-1 Design Precautions 34
3-2 Selecting an Installation Site 35
3-3 Assembling the CPM2B-S Boards 36
3-4 Installing the CPM2B-S 38
3-5 Wiring and Connections 39

SECTION 4
Memory Areas **57**

4-1 Introduction 58
4-2 I/O Allocation for CPM2B-S PCs 63
4-3 I/O Allocation to CompoBus/S Slaves 65
4-4 SR Area 66
4-5 AR Area 69
4-6 PC Setup 73
4-7 Basic PC Operation and I/O Processes 79
4-8 Error Log 84

TABLE OF CONTENTS

SECTION 5
Instruction Set 85

5-1 CPM2B-S Function Codes 86
5-2 Alphabetic List by Mnemonic 87
5-3 Expansion Instructions. 90

SECTION 6
Exchanging Data with CompoBus/S Slaves 91

6-1 Initial Settings 92
6-2 Remote I/O Communications 93
6-3 Communications Status 95

SECTION 7
Exchanging Data with a DeviceNet Master 97

7-1 Initial Settings 98
7-2 Remote I/O Communications 98
7-3 Explicit Message Communications 101
7-4 Status Information 113

SECTION 8
Cycle Time and I/O Response Time 117

8-1 Cycle Time. 118
8-2 I/O Response Time 131
8-3 Interrupt Processing Time 133
8-4 One-to-one PC Link I/O Response Time. 134

SECTION 9
Test Runs and Error Processing 137

9-1 Initial System Checks and Test Run Procedure. 138
9-2 CPM2B-S Test Run Procedure 138
9-3 Self-diagnostic Functions 139
9-4 Troubleshooting Flowcharts 143
9-5 Maintenance Inspections 151
9-6 Battery Replacement 151

Appendices

A Standard Models 153
B Dimensions 157

Index. 159

Revision History 163

About this Manual:

The CPM2B-S001M-DRT is a compact, high-speed board Programmable Controller (PC) that is equipped with all of the functions of the CPM2C-S100C-DRT PC.

This manual describes the features, specifications, and installation of the CPM2B-S001M-DRT (referred to as the CPM2B-S in this manual) and includes the sections described below.

Refer to the *CPM2B Operation Manual* (W371) for details on Expansion I/O Board specifications, connections, and wiring. Refer to information on the CPM2A and CPM2C in the *CPM1/CPM1A/CPM2A/CPM2C/SRM1(-V2) Programming Manual* (W353) for details on CPM2B-S programming and functions. Refer to the *CPM2C-S Operation Manual* (W377) for details on Programming Devices such as connecting a computer running the Support Software or using a Programming Console.

The *SYSMAC-CPT Support Software Quick Start Guide* (W332) and *User Manual* (W333) provide descriptions of ladder diagram operations in a Windows environment. The *WS02-CXPC1-E CX-Programmer User Manual* (W361) and the *CX-Server User Manual* (W362) provide details of operations for the WS02-CXPC1-E CX-Programmer in a Windows environment.

Please read this manual carefully and be sure you understand the information provided before attempting to install and operate the CPM2B-S.

Section 1 describes the CPM2B-S's special features and functions, shows the possible system configurations, and explains the basic operation of the CPM2B-S. Read this section first when using the CPM2B-S for the first time. Refer to the *CPM1/CPM1A/CPM2A/CPM2C/SRM1(-V2) Programming Manual* (W353) for details on programming.

Section 2 provides the technical specifications of the CPM2B-S Boards and describes the main components of the Boards.

Section 3 provides information on installing and wiring a CPM2B-S PC. Be sure to follow the directions and precautions in this section when installing the CPM2B-S in a panel or cabinet, wiring the power supply, or wiring I/O.

Section 4 describes the structure of the PC memory areas and explains how to use them.

Section 5 provides a brief summary of the instruction set. Refer to the *CPM1/CPM1A/CPM2A/CPM2C/SRM1(-V2) Programming Manual* (W353) for details on specific instructions.

Section 6 explains how to use the Board's CompoBus/S Master functions to exchange data with CompoBus/S Slaves.

Section 7 explains how to use the Board's DeviceNet functions to exchange data with a DeviceNet Master.

Section 8 explains the cycle time and I/O response time in CPM2B-S PCs.

Section 9 describes procedures for trial CPM2B-S operation, self-diagnosis functions, and error processing to identify and correct the hardware and software errors that can occur during PC operation.

Appendices provides lists of standard models and Board dimensions.

⚠WARNING Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product, or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

PRECAUTIONS

This section provides general precautions for using the Programmable Controller (PC) and related devices.

The information contained in this section is important for the safe and reliable application of the Programmable Controller. You must read this section and understand the information contained before attempting to set up or operate a PC system.

1 Intended Audience xii
2 General Precautions xii
3 Safety Precautions. xii
4 Operating Environment Precautions xiii
5 Application Precautions xiv

1 Intended Audience

This manual is intended for the following personnel, who must also have knowledge of electrical systems (an electrical engineer or the equivalent).

- Personnel in charge of installing FA systems.
- Personnel in charge of designing FA systems.
- Personnel in charge of managing FA systems and facilities.

2 General Precautions

The user must operate the product according to the performance specifications described in the operation manuals.

Before using the product under conditions which are not described in the manual or applying the product to nuclear control systems, railroad systems, aviation systems, vehicles, combustion systems, medical equipment, amusement machines, safety equipment, and other systems, machines, and equipment that may have a serious influence on lives and property if used improperly, consult your OMRON representative.

Make sure that the ratings and performance characteristics of the product are sufficient for the systems, machines, and equipment, and be sure to provide the systems, machines, and equipment with double safety mechanisms.

This manual provides information for programming and operating the Unit. Be sure to read this manual before attempting to use the Unit and keep this manual close at hand for reference during operation.

⚠WARNING It is extremely important that a PC and all PC Units be used for the specified purpose and under the specified conditions, especially in applications that can directly or indirectly affect human life. You must consult with your OMRON representative before applying a PC System to the above-mentioned applications.

3 Safety Precautions

⚠WARNING Do not attempt to take any board apart while the power is being supplied. Doing so may result in electric shock.

⚠WARNING Do not touch any of the terminals, terminal blocks or, for the CPM2B-S, the CPU board or expansion I/O board while the power is being supplied. Doing so may result in electric shock.

⚠WARNING When handling the Memory Backup Battery, never drop, disassemble, distort, short-circuit, heat to a high temperature, or throw into fire. Otherwise the Battery may explode, catch fire, or leak fluid.

⚠WARNING Do not attempt to disassemble, repair, or modify any Units. Any attempt to do so may result in malfunction, fire, or electric shock.

⚠WARNING Provide safety measures in external circuits (i.e., not in the Programmable Controller), including the following items, in order to ensure safety in the system if an abnormality occurs due to malfunction of the PC or another external factor affecting the PC operation. Not doing so may result in serious accidents.

- Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided in external control circuits.
- The PC will turn OFF all outputs when its self-diagnosis function detects any error or when a severe failure alarm (FALS) instruction is executed. As a countermeasure for such errors, external safety measures must be provided to ensure safety in the system.
- The PC outputs may remain ON or OFF due to deposition or burning of the output relays or destruction of the output transistors. As a countermeasure for such problems, external safety measures must be provided to ensure safety in the system.

⚠WARNING When transferring programs to other nodes, or when making changes to I/O memory, confirm the safety of the destination node before transfer. Not doing so may result in injury.

⚠Caution Execute online edit only after confirming that no adverse effects will be caused by extending the cycle time. Otherwise, the input signals may not be readable.

⚠Caution Tighten the screws on the terminal block to the torque specified in the operation manual. The loose screws may result in burning or malfunction.

4 Operating Environment Precautions

⚠Caution Do not operate the control system in the following places:

- Locations subject to direct sunlight.
- Locations subject to temperatures or humidity outside the range specified in the specifications.
- Locations subject to condensation as the result of severe changes in temperature.
- Locations subject to corrosive or flammable gases.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to exposure to water, oil, or chemicals.
- Locations subject to shock or vibration.

⚠Caution Take appropriate and sufficient countermeasures when installing systems in the following locations:

- Locations subject to static electricity or other forms of noise.
- Locations subject to strong electromagnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power supplies.

⚠**Caution** The operating environment of the PC System can have a large effect on the longevity and reliability of the system. Improper operating environments can lead to malfunction, failure, and other unforeseeable problems with the PC System. Be sure that the operating environment is within the specified conditions at installation and remains within the specified conditions during the life of the system.

5 Application Precautions

Observe the following precautions when using the PC System.

⚠**WARNING** Always heed these precautions. Failure to abide by the following precautions could lead to serious or possibly fatal injury.

- Always turn OFF the power supply to the PC before attempting any of the following. Not turning OFF the power supply may result in malfunction or electric shock.
  - Mounting or dismounting the CPU board or expansion I/O board.
  - Setting switches or rotary switches.
  - Connecting or wiring the cables.
  - Connecting or disconnecting the connectors.

⚠**Caution** Failure to abide by the following precautions could lead to faulty operation of the PC or the system, or could damage the PC. Always heed these precautions.

- Fail-safe measures must be taken by the customer to ensure safety in the event of incorrect, missing, or abnormal signals caused by broken signal lines, momentary power interruptions, or other causes.
- Construct a control circuit so that power supply for the I/O circuits does not come ON before power supply for the PC. If power supply for the I/O circuits comes ON before power supply for the PC, normal operation may be temporarily interrupted.
- If the operating mode is changed from RUN or MONITOR mode to PROGRAM mode, with the IOM Hold Bit ON, the output will hold the most recent status. In such a case, ensure that the external load does not exceed specifications. (If operation is stopped because of an operation error (including FALS instructions), the values in the internal memory of the CPU board will be saved, but the outputs will all turn OFF.)
- Always use the power supply voltage specified in the operation manuals. An incorrect voltage may result in malfunction or burning.
- Take appropriate measures to ensure that the specified power with the rated voltage is supplied. Be particularly careful in places where the power supply is unstable. An incorrect power supply may result in malfunction.
- Install external breakers and take other safety measures against short-circuiting in external wiring. Insufficient safety measures against short-circuiting may result in burning.
- Do not apply voltages to the input terminals in excess of the rated input voltage. Excess voltages may result in burning.

- Do not apply voltages or connect loads to the output terminals in excess of the maximum switching capacity. Excess voltage or loads may result in burning.
- Be sure that all the mounting screws, terminal screws, and cable connector screws are tightened to the torque specified in the relevant manuals. Incorrect tightening torque may result in malfunction.
- When wiring the CPM2B-S, take countermeasures to prevent wiring cuttings from coming into contact with the product, such as covering the whole product with a dustproof cover. If wiring cuttings adhere to the PCB or circuit elements they may cause short-circuiting.
- Be sure to perform wiring in accordance with the relevant operation manual. Incorrect wiring may result in burning.
- Double-check all the wiring before turning ON the power supply. Incorrect wiring may result in burning.
- Be sure that the terminal blocks, expansion cables, and other items with locking devices are properly locked into place. Improper locking may result in malfunction.
- Be sure that terminal blocks and connectors are connected in the specified direction with the correct polarity. Not doing so may result in malfunction.
- Check the user program for proper execution before actually running it on the PC. Not checking the program may result in an unexpected operation.
- Confirm that no adverse effect will occur in the system before attempting any of the following. Not doing so may result in an unexpected operation.
  - Changing the operating mode of the PC.
  - Force-setting/force-resetting any bit in memory.
  - Changing the present value of any word or any set value in memory.
- Resume operation only after transferring to the new CPU board the contents of the DM and HR Areas required for resuming operation. Not doing so may result in an unexpected operation.
- Do not pull on the cables or bend the cables beyond their natural limit. Doing either of these may break the cables.
- Do not place objects on top of the cables. Doing so may break the cables.
- Under no circumstances should batteries be short-circuited between positive (+) and negative (–) terminals, charged, disassembled, heated, or thrown into fire.
- When replacing parts, be sure to confirm that the rating of a new part is correct. Not doing so may result in malfunction or burning.
- When transporting or storing the CPM2B-S, cover the circuit boards in antistatic material to protect them from static electricity and maintain the proper storage temperature.
- Before touching the Unit, be sure to first touch a grounded metallic object in order to discharge any static build-up. Not doing so may result in malfunction or damage.
- Do not touch the expansion I/O connecting cable while the power is being supplied in order to prevent any malfunction due to static electricity.
- Do not touch CPM2B-S circuit boards or the components mounted to them with your bare hands. There are sharp leads and other parts on the boards that may cause injury if handled improperly.
- When disposing the product, observe local ordinances and regulations.

SECTION 1
Introduction

This section describes the CPM2B-S's special features and functions, shows the possible system configurations, and outlines the steps required before operation. Read this section first when using the CPM2B-S for the first time.

Refer to the *CPM2B Operation Manual* (W371) for details on Expansion I/O Board specifications, connections, and wiring.
Refer to information on the CPM2A and CPM2C in the *CPM1/CPM1A/CPM2A/CPM2C/SRM1(-V2) Programming Manual* (W353) for details on CPM2C-S programming and functions.
Refer to the *CPM2C-S Operation Manual* (W377) for details on Programming Devices such as connecting a computer running the Support Software or using a Programming Console.

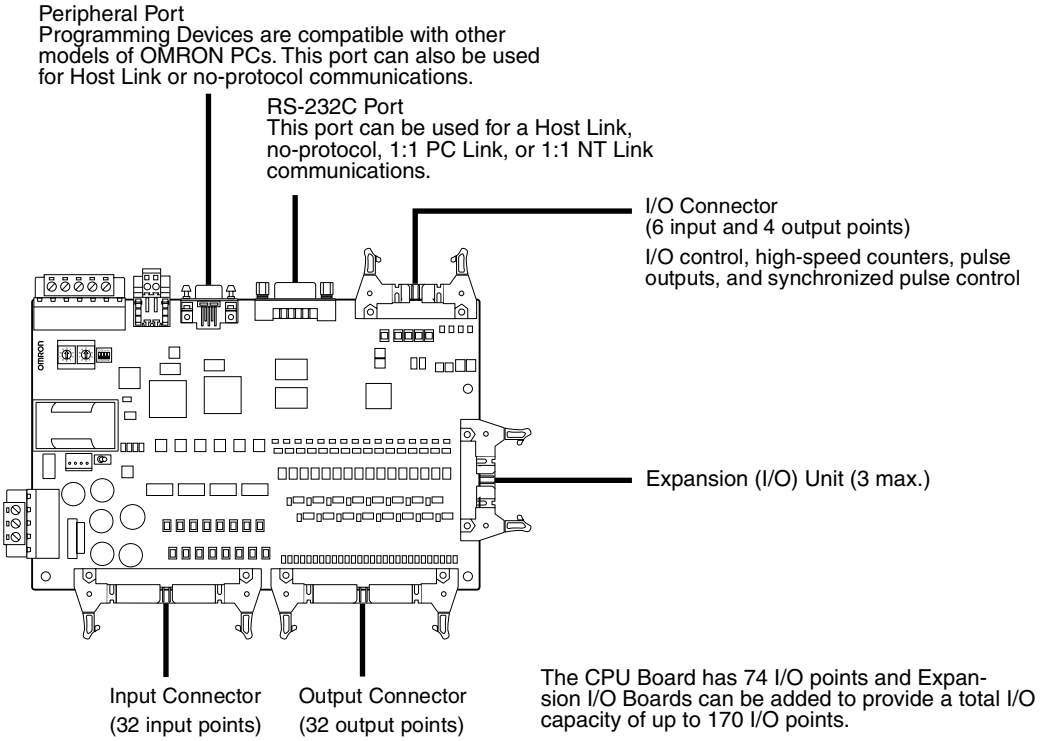
1-1 CPM2B-S Features and Functions 2
1-1-1 CPM2B-S Features 2
1-1-2 Overview of CPM2B-S Functions 7
1-2 System Configurations 8
1-2-1 CPU Board 8
1-2-2 Expansion I/O Boards 8
1-2-3 Connecting a Programming Console 9
1-2-4 Support Software 10
1-2-5 One-to-one Computer Connections 10
1-2-6 One-to-N Computer Connections 11
1-2-7 OMRON PT Connections 12
1-2-8 One-to-one PC Link Connections 13
1-3 Structure and Operation 14
1-3-1 CPU Board Structure 14
1-3-2 Operating Modes 15
1-3-3 Operating Mode at Startup 15
1-3-4 PC Operation at Startup 16
1-3-5 Cyclic Operation and Interrupts 17

1-1 CPM2B-S Features and Functions

1-1-1 CPM2B-S Features

The CPM2B-S PCs are compact Board PCs that are equipped with the functions of CPM2C-S PCs. In addition to the CompoBus/S Master function and DeviceNet I/O Link Function, the PCs are equipped with a variety of other advanced features including interrupt inputs, high-speed counters, pulse outputs, and synchronized pulse control.

- The compact Board design is ideal for incorporation into control equipment.
- The CPU Board itself can handle a wide range of machine control applications, so it is ideal for use as a built-in control unit in control equipment.
- The CPM2B-S is equipped with a full complement of communications functions to provide communications with personal computers, other OMRON PCs, and OMRON Programmable Terminals. These communications capabilities allow the user to design a low-cost distributed production system.


Peripheral Port
Programming Devices are compatible with other models of OMRON PCs. This port can also be used for Host Link or no-protocol communications.
RS-232C Port
This port can be used for a Host Link, no-protocol, 1:1 PC Link, or 1:1 NT Link communications.
I/O Connector
(6 input and 4 output points)
I/O control, high-speed counters, pulse outputs, and synchronized pulse control
Expansion (I/O) Unit (3 max.)
Input Connector
(32 input points)
Output Connector
(32 output points)
The CPU Board has 74 I/O points and Expansion I/O Boards can be added to provide a total I/O capacity of up to 170 I/O points.

Basic Functions

CPU Board I/O

The CPM2B-S CPU Board itself is equipped with 74 I/O points in an I/O connector, input connector, and output connector. The power supply is 24 V DC only.

Expansion I/O Boards

Up to 3 Expansion I/O Boards can be connected to the CPU Board to increase the PC's I/O capacity to a maximum of 170 I/O points. There are two types of 32-point Expansion I/O Boards available: One with relay outputs and one with sinking transistor outputs.

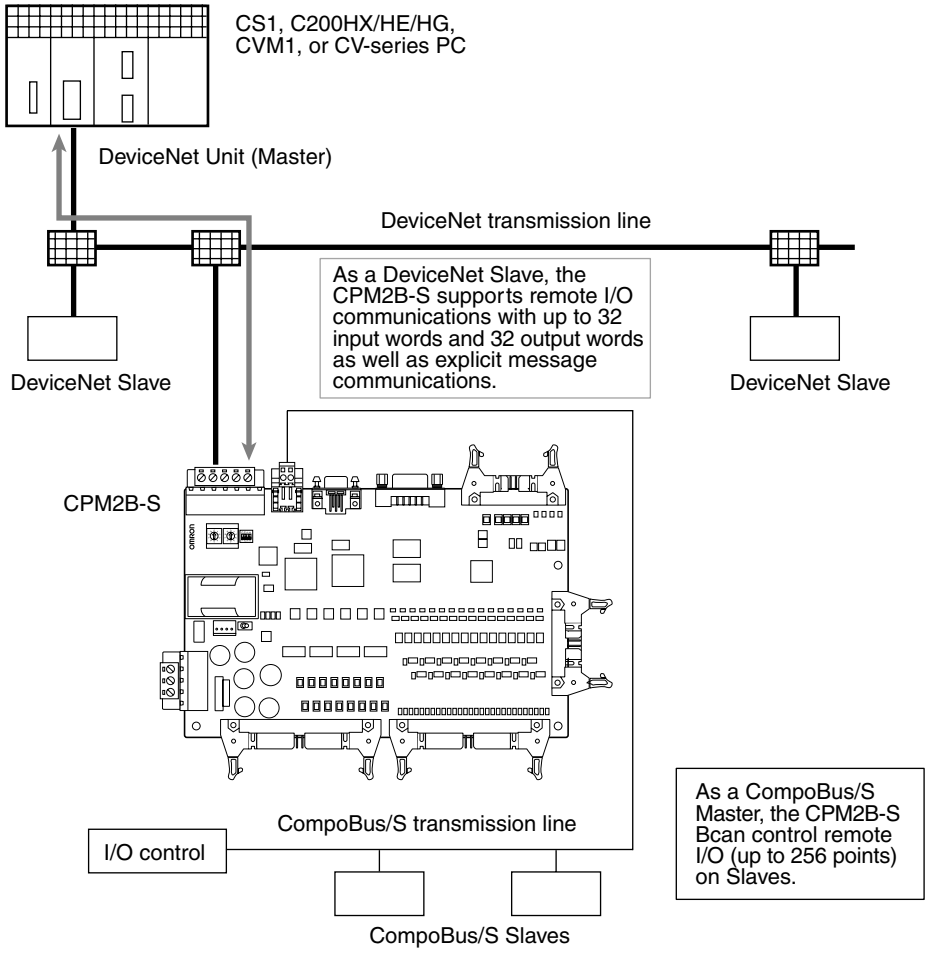
Share Programming Devices

The same Programming Devices, such as Programming Consoles and Support Software, can be used for the C200H, C200HS, C200HX/HG/HE, CQM1, CPM1, CPM1A, CPM2A, CPM2C, and SRM1 (-V2) PCs, so existing ladder program resources can be used effectively.

CompoBus/S Master Functions

Up to 32 CompoBus/S Slaves can be connected to create a Remote I/O Link with up to 256 I/O points. It is easy to build an efficient, long-range distributed system with less wiring by connecting CompoBus/S I/O Terminals, Analog Terminals, Sensor Terminals, and Bit Chain Terminals.

Example System Configuration


CS1, C200HX/HE/HG,
CVM1, or CV-series PC
DeviceNet Unit (Master)
DeviceNet transmission line
As a DeviceNet Slave, the CPM2B-S supports remote I/O communications with up to 32 input words and 32 output words as well as explicit message communications.
DeviceNet Slave
DeviceNet Slave
CPM2B-S
CompoBus/S transmission line
I/O control
As a CompoBus/S Master, the CPM2B-S Bcan control remote I/O (up to 256 points) on Slaves.
CompoBus/S Slaves

DeviceNet Slave Functions

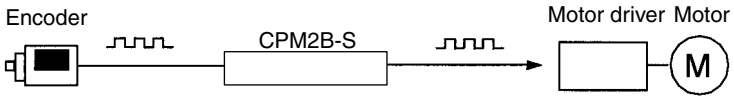
When the CPM2B-S is used as a DeviceNet Slave, an I/O Link of up to 1,024 points (512 inputs and 512 outputs) can be created with the Master. The input and output areas used in the I/O Link can be allocated independently and the data areas, starting addresses, and size of these Read/Write areas can be specified freely. (The Read/Write areas can be set in the PC Setup or using the DeviceNet Configurator.)

Explicit message communications can be initiated from the Master to read or write data in any data area in the CPM2B-S.

Built-in Motor Control Capability

Synchronized Pulse Control

Synchronized pulse control provides an easy way to synchronize the operation of a peripheral piece of equipment with the main equipment. The output pulse frequency can be controlled as some multiple of the input pulse frequency, allowing the speed of a peripheral piece of equipment (such as a supply conveyor) to be synchronized with the speed of the main piece of equipment.



Pulses are output as a fixed multiple of the input frequency.

High-speed Counters and Interrupts

The CPM2B-S has a total of five high-speed counter inputs. The one high-speed counter input has a response frequency of 20 kHz/5 kHz and the four interrupt inputs in counter mode have a response frequency of 2 kHz.

The high-speed counter can be used in any one of the four input modes: differential phase mode (5 kHz), pulse plus direction input mode (20 kHz), up/down pulse mode (20 kHz), or increment mode (20 kHz). Interrupts can be triggered when the count matches a set value or falls within a specified range.

The interrupt inputs in counter mode can be used for incrementing counters or decrementing counters (2 kHz) and trigger an interrupt (executing the interrupt program) when the count matches the target value.

Easy Position Control with Pulse Outputs

CPM2B-S PCs have two outputs that can produce 10 Hz to 10 kHz pulses (single-phase outputs).

When used as single-phase pulse outputs, there can be two outputs with a frequency range of 10 Hz to 10 kHz with a fixed duty ratio or 0.1 to 999.9 Hz with a variable duty ratio (0 to 100% duty ratio).

When used as pulse plus direction or up/down pulse outputs, there can be just one output with a frequency range of 10 Hz to 10 kHz.

High-speed Input Capabilities for Machine Control

High-speed Interrupt Input Function

There are four inputs used for interrupt inputs (shared with quick-response inputs and interrupt inputs in counter mode) with a minimum input signal width of 50 μs and response time of 0.3 ms. When an interrupt input goes ON, the main program is stopped and the interrupt program is executed.

Quick-response Input Function

There are four inputs used for quick-response inputs (shared with interrupt inputs and interrupt inputs in counter mode) that can reliably read input signals with a signal width as short as 50 μs.

Stabilizing Input Filter Function

The input time constant for all inputs can be set to 1 ms, 2 ms, 3 ms, 5 ms, 10 ms, 20 ms, 40 ms, or 80 ms. The effects of chattering and external noise can be reduced by increasing the input time constant.

Other Functions

Interval Timer Interrupts

The interval timer can be set between 0.5 and 319,968 ms and can be set to generate just one interrupt (one-shot mode) or periodic interrupts (scheduled interrupt mode).

Analog Settings

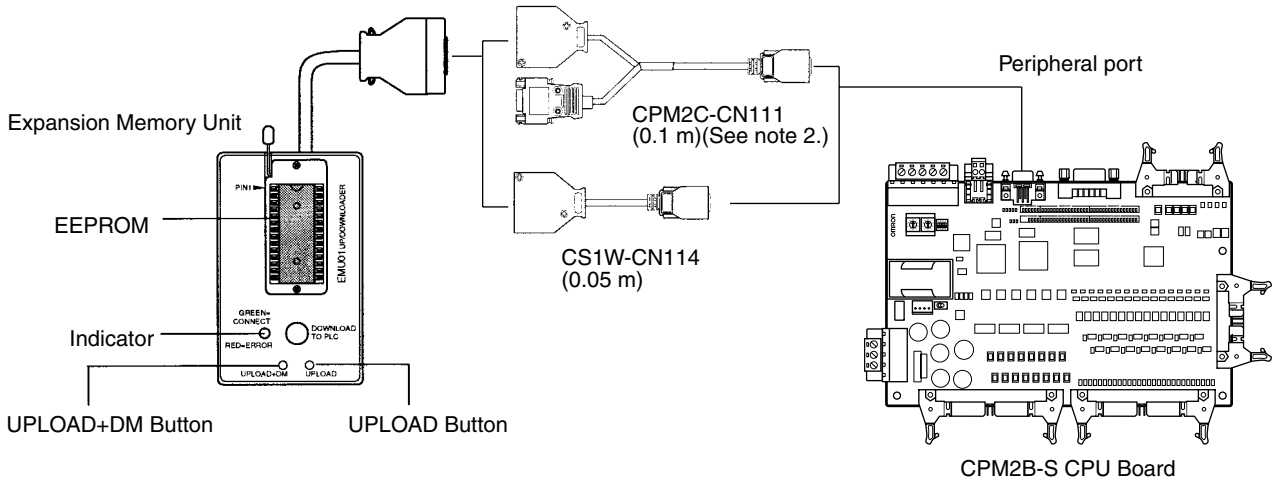
There are two controls on the CPU Board that can be turned to change the analog settings (0 to 200 BCD) in IR 250 and IR 251. These controls can be used to easily change or fine-tune machine settings such as a conveyor belt's pause time or feed rate.

Long-term Timer

TIML(–) is a long-term timer that accommodates set values up to 99,990 seconds (27 hours, 46 minutes, 30 seconds). When combined with the SECONDS TO HOURS conversion instruction (HMS(–)), the long-term timer provides an easy way to control equipment scheduling.

Expansion Memory Unit

The CPM1-EMU01-V1 Expansion Memory Unit is a program loader for small-size or micro PCs. Using the CPM1-EMU01-V1, simple on-site transfer of user programs and data memory is possible with PCs.



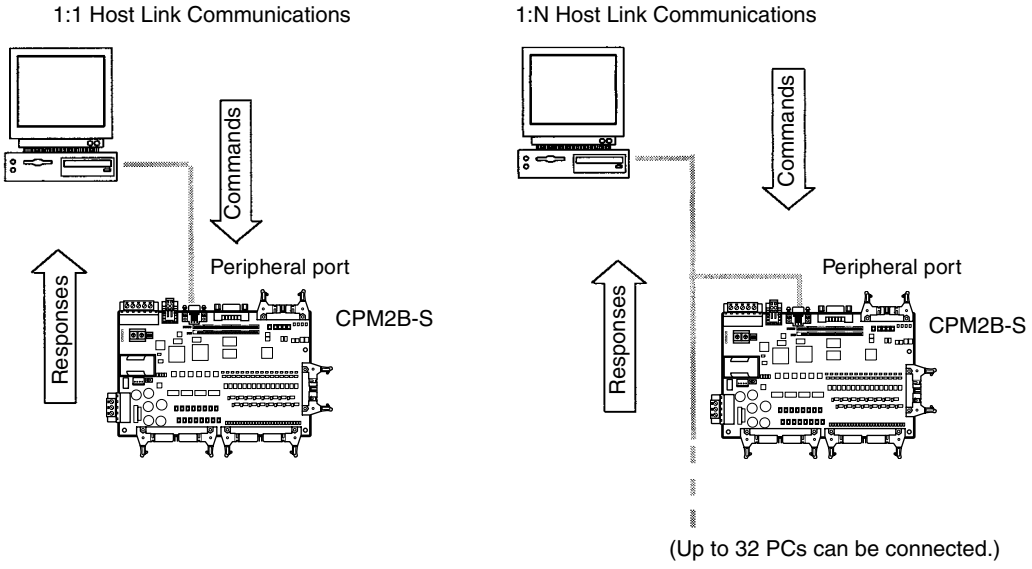
Note

1. Refer to the *CPM2C-S Operation Manual* (W377) for details on the CPM1-EMU01-V1.
2. The CPM2C-CN111 can be connected only to the peripheral port.

Complete Communications Capabilities

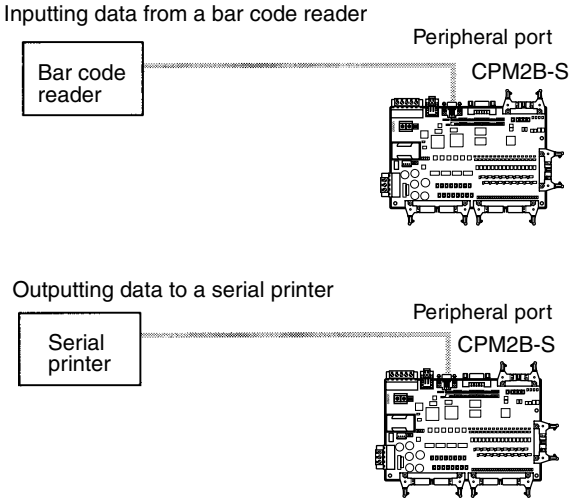
Host Link

A Host Link connection can be made through the PC's RS-232C port or Peripheral port. A personal computer or Programmable Terminal connected in Host Link mode can be used for operations such as reading/writing data in the PC's I/O memory or reading/changing the PC's operating mode. (Only 1:1 connections are possible with a Programmable Terminal.)



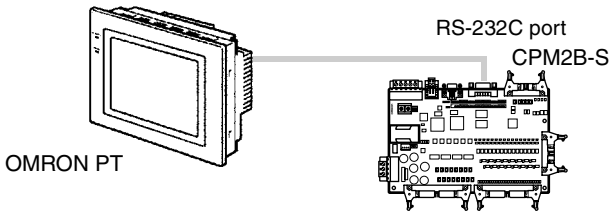
No-protocol Communications

The TXD(48) and RXD(47) instructions can be used in no-protocol mode to exchange data with standard serial devices. For example, data can be received from a bar code reader or transmitted to a serial printer. The serial devices can be connected to the RS-232C port or Peripheral port.



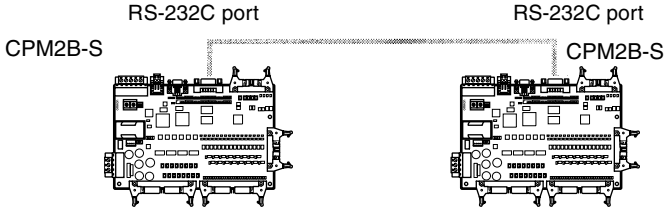
High-speed 1:1 NT Link Communications

In a 1:1 NT Link, an OMRON Programmable Terminal (PT) can be connected directly to the CPM2B-S. The PT must be connected to the RS-232C port; it cannot be connected to the Peripheral port.



One-to-one PC Link

A CPM2B-S can be linked directly to another CPM2B-S, CQM1, CPM1, CPM1A, CPM2A, CPM2C, SRM1(-V2), C200HS or C200HX/HG/HE PC. The 1:1 PC Link allows automatic data link connections. The PCs must be connected through the RS-232C ports; they cannot be connected through the Peripheral ports.



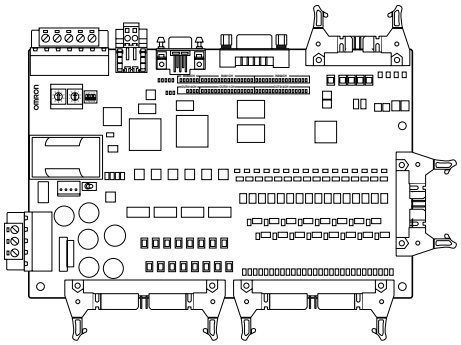
1-1-2 Overview of CPM2B-S Functions

<table>
<tr><th>Main function</th><th colspan="2">Variations/Details</th></tr>
<tr><td>CompoBus/S Master functions</td><td colspan="2">• Remote I/O devices can be allocated up to 256 I/O points (128 inputs and 128 outputs) in input area IR 020 to IR 027 and output area IR 030 to IR 037.
• The node numbers can be set to 0 to 7 (128-point mode) or 0 to 15 (256-point mode).
• The communications mode can be set to high-speed mode (max. length 100 m) or long-distance mode (max. length 500 m).</td></tr>
<tr><td>DeviceNet Slave functions</td><td colspan="2">• Up to 64 words (32 input words and 32 output words) can be allocated to the DeviceNet Master's I/O. The Master's I/O can be allocated to the following data areas.
IR 000 to IR 049
IR 200 to IR 227
DM 0000 to DM 2047
LR 00 to LR 15
HR 00 to HR 19
AR 00 to AR 23 (CPM2B-S → Master; read-only)
TC 000 to TC 255
• Explicit message communications are supported. Any CPM2B-S data area can be accessed from the DeviceNet Master.
• The communications speed can be set to 500 kbps (total network length 100 m max.), 250 kbps (total network length 250 m max.), or 125 kbps (total network length 500 m max.).</td></tr>
<tr><td rowspan="4">Interrupts</td><td colspan="2">Interrupt inputs
4 inputs, see note 1.
Response time: 50 μs</td></tr>
<tr><td rowspan="2">Interval timer interrupts
1 input
Set value: 0.5 to 319,968 ms
Precision: 0.1 ms</td><td>Scheduled interrupts</td></tr>
<tr><td>One-shot interrupt</td></tr>
<tr><td colspan="2">Interrupt inputs in counter mode
4 inputs, see note 1.
Incrementing counter (2 kHz)
Decrementing counter (2 kHz)</td><td>No interrupt
Count-up interrupt</td></tr>
<tr><td>High-speed counters</td><td>High-speed counter
1 input, see note 2.
Differential phase mode (5 kHz)
Pulse plus direction input mode (20 kHz)
Up/down input mode (20 kHz)
Increment mode (20 kHz)</td><td>No interrupt
Count-check interrupt
(An interrupt can be generated when the count equals the set value or the count lies within a preset range.)</td></tr>
<tr><td>Pulse outputs</td><td colspan="2">2 outputs:
Single-phase pulse output without acceleration/deceleration (See note 3.)
10 Hz to 10 kHz
2 outputs:
Variable duty ratio pulse output (See note 3.)
0.1 to 999.9 Hz, duty ratio 0 to 100%
1 output:
Pulse output with trapezoidal acceleration/deceleration (See note 3.)
Pulse plus direction output, up/down pulse output, 10 Hz to 10 kHz</td></tr>
<tr><td>Synchronized pulse control</td><td colspan="2">1 point, see notes 2 and 3.
Input frequency range: 10 to 500 Hz, 20 Hz to 1 kHz, or 300 Hz to 20 kHz
Output frequency range: 10 Hz to 10 kHz</td></tr>
<tr><td>Quick-response input</td><td colspan="2">4 inputs, see note 1.
Maximum input signal width: 50 μs</td></tr>
<tr><td>Input time constant</td><td colspan="2">Determines the input time constant for all inputs except for those for IR 001 and IR 002. (Settings: 1, 2, 3, 5, 10, 20, 40, or 80 ms)</td></tr>
<tr><td>Error log</td><td colspan="2">Records the error code.</td></tr>
</table>

Note
1. These four inputs are shared by interrupt inputs, interrupt inputs in counter mode, and quick-response inputs, but each input can be used for only one purpose.
2. This input is shared by the high-speed counter and synchronized pulse control functions.
3. This output is shared by the pulse output and synchronized pulse control functions. These functions can be used with transistor outputs only.

1-2 System Configurations

1-2-1 CPU Board

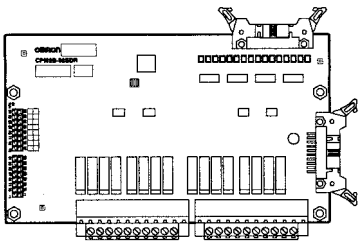


CPU Board	Inputs	Outputs	Battery	RS-232C port	Model
74 I/O points (38 inputs, 36 outputs)	32 in input connector, 6 in I/O connector	32 in output connector, 4 in I/O connector	Optional	Yes	CPM2B-S001M-DRT

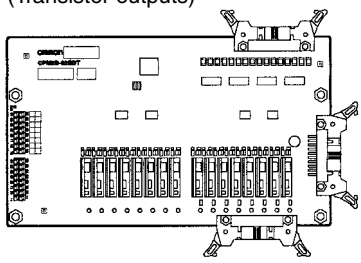
1-2-2 Expansion I/O Boards

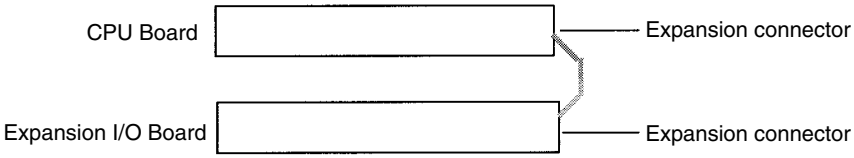
Up to 3 Expansion I/O Boards can be connected to the CPU Board.

Expansion I/O Board with 32 I/O points (Relay outputs)



Expansion I/O Board with 32 I/O points (Transistor outputs)





A PC with 170 I/O points (the maximum) can be assembled by connecting three Expansion I/O Boards. The following configuration provides 86 inputs and 84 sinking transistor outputs:

CPM2B-S (38 inputs, 36 outputs) 1 Board + CPM2B-32EDT (16 inputs, 16 outputs) 3 Boards = 86 inputs, 84 outputs

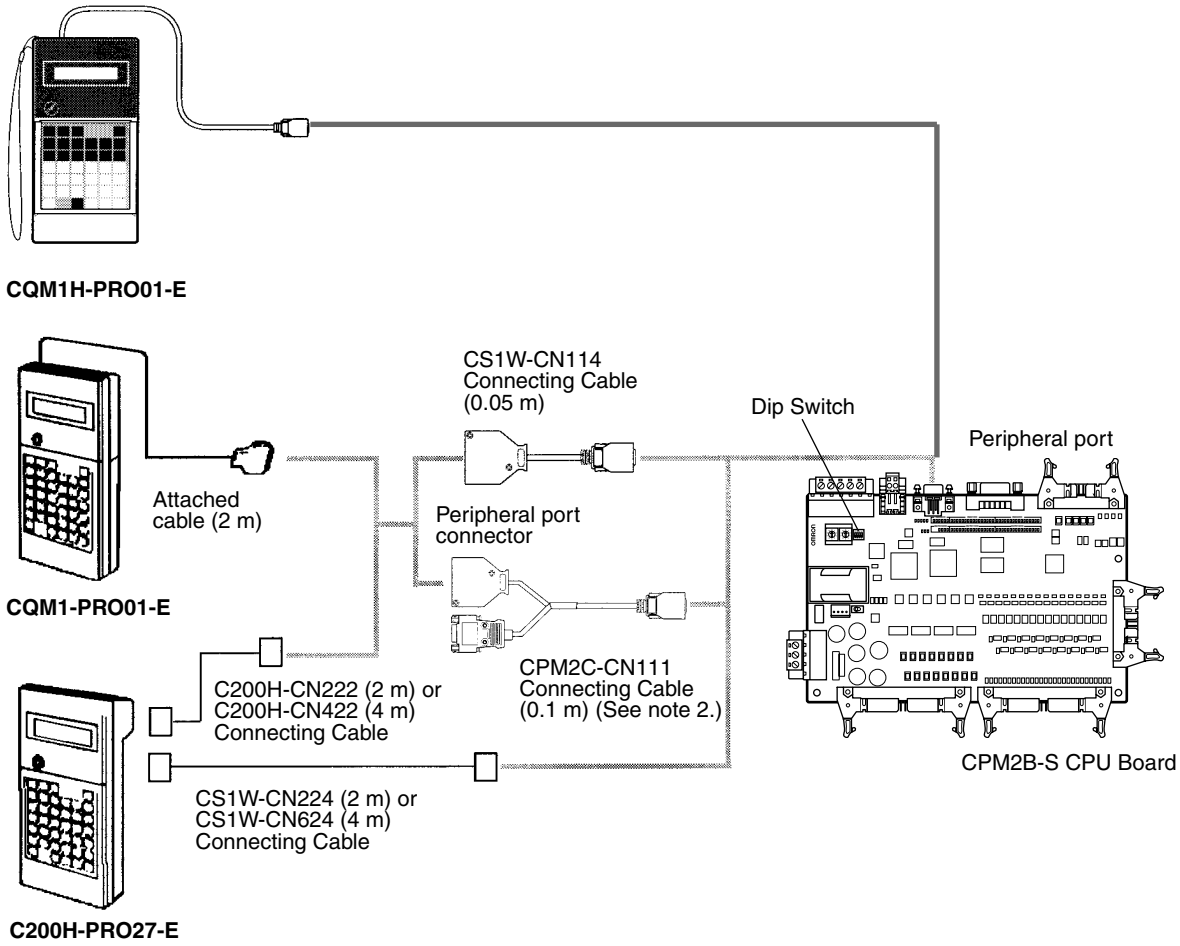
Expansion I/O Boards

Expansion I/O Board	Inputs	Outputs	Model
32 I/O points (16 inputs, 16 outputs)	16 inputs, 24 V DC	16 relay outputs (terminal block)	CPM2B-32EDR
	16 inputs, 24 V DC	16 sinking transistor outputs (connector)	CPM2B-32EDT

Note When an NT-AL001-E Adapter is connected to the RS-232C port, only one Expansion I/O Board can be connected because of power supply limitations. Refer to the *CPM2B Operation Manual* (W371) for details on Expansion I/O Board specifications and mounting instructions.

1-2-3 Connecting a Programming Console

A Programming Console can be connected to the CPM2B-S CPU Board's peripheral port, as shown below.



Note

1. Only the peripheral port connector can be used when a CPM2C-CN111 Connecting Cable is connected.
2. Refer to the *CPM2B Operation Manual* (W371) or the *CPM2C-S Operation Manual* (W377) for Programming Console operating procedures.

1-2-4 Support Software

A personal computer running the CX-Programmer or SYSMAC-CPT Support Software (in MS Windows) or the SSS (in MS-DOS) can be connected to the CPU Board's Peripheral port or RS-232C port. Refer to *1-2-5 One-to-one Computer Connections* for details on the computer connection.

The setting of DIP Switch pin 3 determines whether the communications settings in the PC Setup or the standard settings will be used, as shown in the following table.

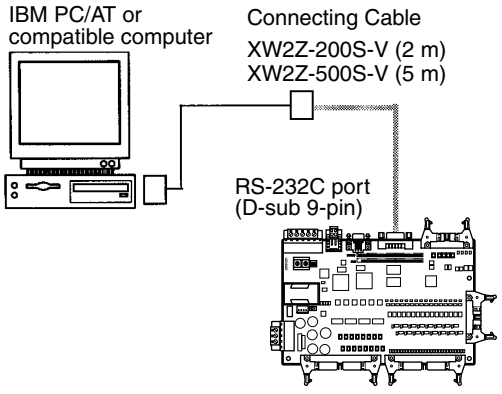
Pin 3 setting	Communications settings	
	Peripheral port	RS-232C port
ON	Standard settings (The standard settings and PC Setup default settings are Host Link communications at 9,600 bps with 1 start bit, 7-bit data, 2 stop bits, and even parity.)	
OFF	PC Setup settings in DM 6650 and DM 6651	PC Setup settings in DM 6645 and DM 6646

When using the SSS, set the PC Model to "CQM1." When using the SYSMAC-CPT, set the PC Model to "CQM1" with the "CPU43" CPU version.

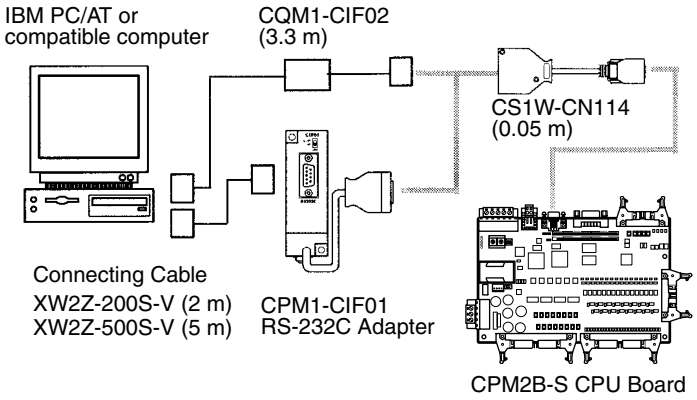
1-2-5 One-to-one Computer Connections

Use one of the connecting cables shown in the following diagram to connect a personal computer with Support Software to the CPM2B-S for a 1:1 Host Link communications or no-protocol (serial) communications.

RS-232C Port Connection



Peripheral Port Connection

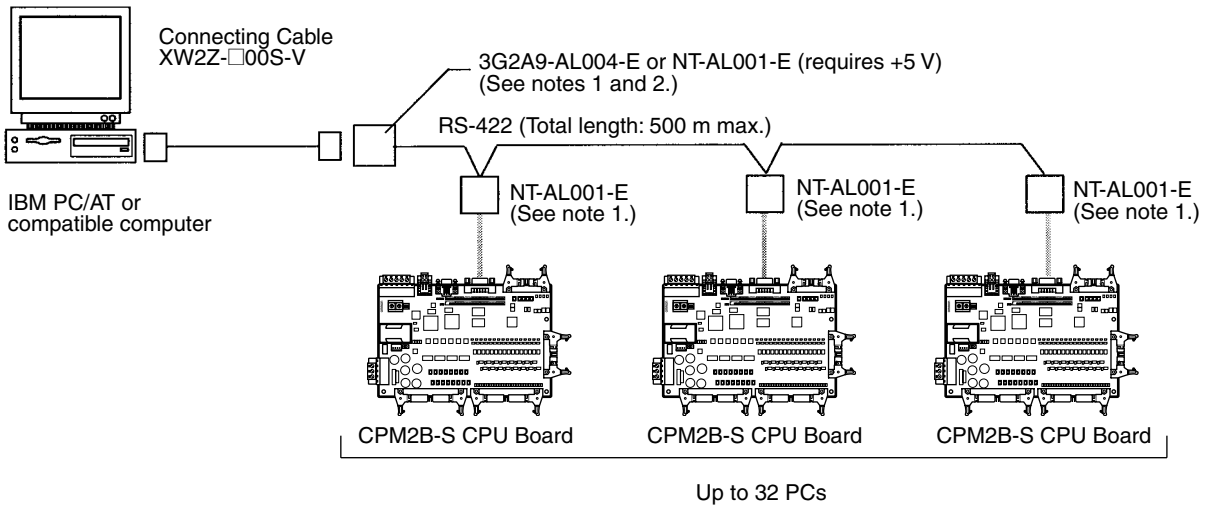


Note
1. The CQM1-CIF11 Connecting Cable cannot be used.
2. Refer to *Appendix A Standard Models* for details on the Support Software that can be used with the CPM2B-S.

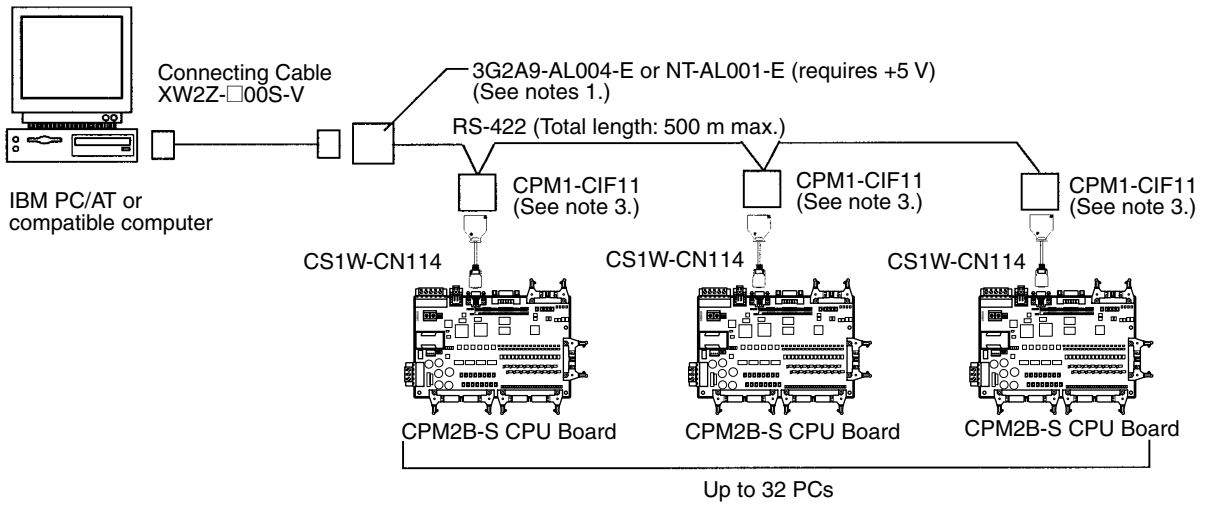
1-2-6 One-to-N Computer Connections

Up to 32 OMRON PCs, including CPM2B-S PCs, can be connected to a host computer.

Using the RS-232C Port



Using the Peripheral Port



Note

1. The NT-AL001-E must be supplied externally with 5 V DC. When an NT-AL001-E is connected to a CPM2B-S PC, pin 6 of the CPM2B-S's RS-232C port supplies +5 V DC and an external power supply is not necessary. When the NT-AL001-E is connected to a host computer, it is necessary to supply 5 V DC from an external power supply.

   If an NT-AL001-E is connected to the CPM2B-S's RS-232C port, only one Expansion I/O Board can be connected to the CPU Board because the NT-AL001-E draws its 5-V DC power from the CPU Board.

   Use an XW2Z-070T-1 (0.7 m) or XW2Z-200T-1 (2 m) cable to connect the NT-AL001-E to the CPM2B-S's RS-232C port.

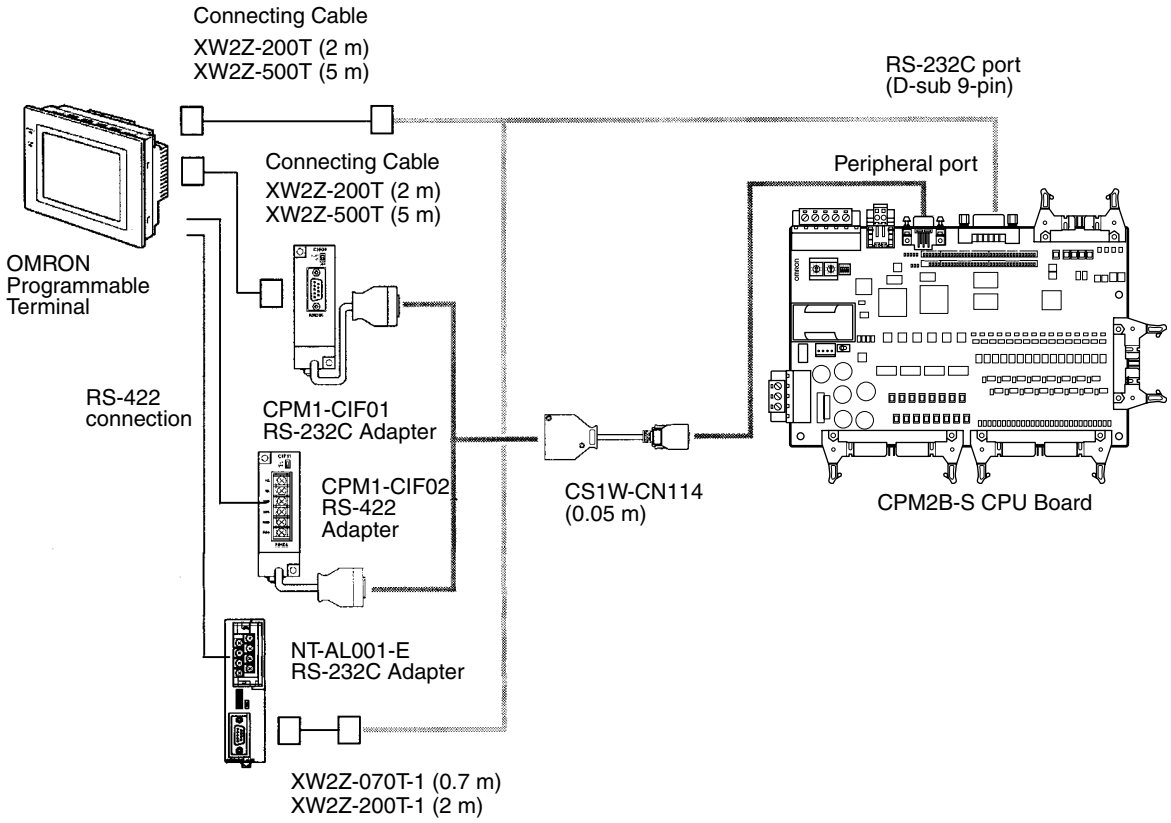
2. The 3G2A9-AL004-E requires an external AC power supply (110 V AC or 220 V AC).

3. The CPM1-CIF11 is supplied +5 V DC from the peripheral port so an external power supply is not necessary.

1-2-7 OMRON PT Connections

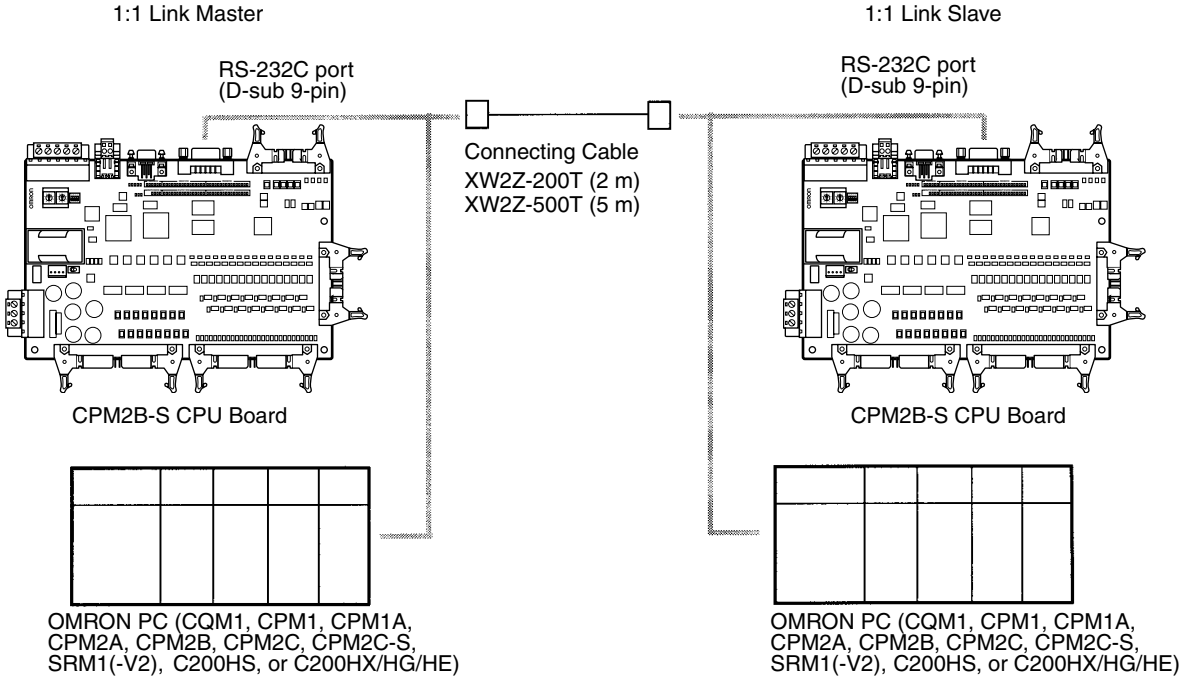
In a 1:1 NT Link, a CPM2B-S can be connected directly to a Programmable Terminal through the RS-232C port. (The Programmable Terminal cannot be connected directly to the peripheral port.)

An OMRON PT can also be connected to the CPM2B-S with a host link connection. Either the RS-232C port or peripheral port can be used for a host link connection.



1-2-8 One-to-one PC Link Connections

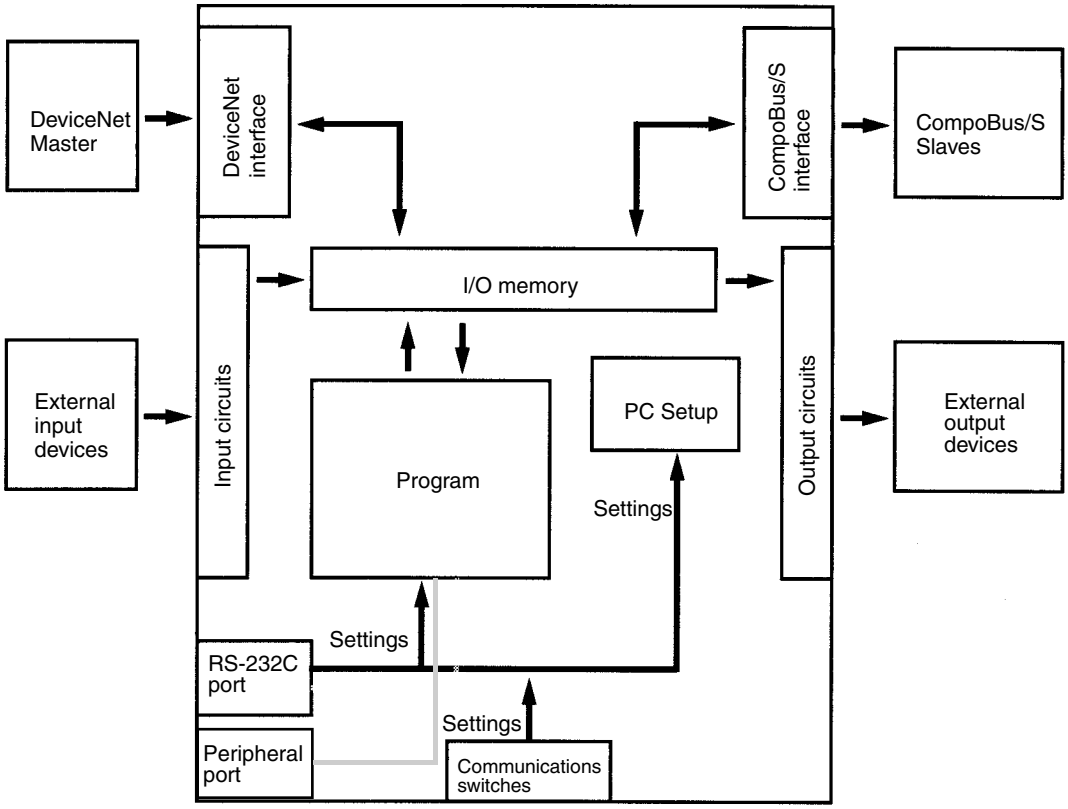
A CPM2B-S can be linked to another CPM2B-S, a CQM1, CPM1, CPM1A, CPM2A, CPM2C, CPM2C-S, CPM2B, SRM1 (-V2) or a C200HS or C200HX/HG/HE PC. The PCs must be connected through the RS-232C ports; they cannot be connected through the Peripheral ports.


1:1 Link Master
1:1 Link Slave
RS-232C port
(D-sub 9-pin)
RS-232C port
(D-sub 9-pin)
Connecting Cable
XW2Z-200T (2 m)
XW2Z-500T (5 m)
CPM2B-S CPU Board
CPM2B-S CPU Board
OMRON PC (CQM1, CPM1, CPM1A, CPM2A, CPM2B, CPM2C, CPM2C-S, SRM1(-V2), C200HS, or C200HX/HG/HE)
OMRON PC (CQM1, CPM1, CPM1A, CPM2A, CPM2B, CPM2C, CPM2C-S, SRM1(-V2), C200HS, or C200HX/HG/HE)

1-3 Structure and Operation

1-3-1 CPU Board Structure

The following diagram shows the internal structure of the CPU Board.



I/O Memory

The program reads and writes data in this memory area during execution. Part of the I/O memory contains the bits that reflect the status of the PC's inputs and outputs. Parts of the I/O memory are cleared when the power is turned ON and other parts are retained.

Note Refer to *SECTION 4 Memory Areas* for more details on I/O memory.

Program

This is the program written by the user. The CPM2B-S executes the program cyclically. (Refer to *1-3-5 Cyclic Operation and Interrupts* for details.)

The program can be divided broadly into two parts: the "main program" that is executed cyclically and the "interrupt programs" that are executed only when the corresponding interrupt is generated.

PC Setup

The PC Setup contains various startup and operating parameters. The PC Setup parameters can be changed from a Programming Device only; they cannot be changed from the program.

Some parameters are accessed only when PC's power supply is turned on and others are accessed regularly while the power is on. It will be necessary to turn the power off and then on again to enable a new setting if the parameter is accessed only when the power is turned on.

Note Refer to *4-6 PC Setup* for more details.

Communications Switches (Dip Switch Pin 1 to 3)

The Communications Switches (Dip Switch Pin 1 to 3) determine whether the peripheral port and RS-232C port operate with the standard communications

settings or the communications settings in the PC Setup. Refer to *2-2 Board Components and their Functions* for more details.

1-3-2 Operating Modes

CPM2B-S CPU Boards have 3 operating modes: PROGRAM, MONITOR, and RUN.

PROGRAM Mode

The program cannot be executed in PROGRAM mode. This mode is used to perform the following operations in preparation for program execution

- Changing initial/operating parameters such as those in the PC Setup
- Writing, transferring, or checking the program
- Checking wiring by force-setting and force-resetting I/O bits

⚠ Caution The PC continues to refresh I/O bits even if the PC is in PROGRAM mode, so devices connected to output points on the CPU Board or Expansion I/O Boards may operate unexpectedly if the corresponding output bit is turned ON by changing the contents of I/O memory from a Programming Device.

MONITOR Mode

The program is executed in MONITOR mode and the following operations can be performed from a Programming Device. In general, MONITOR mode is used to debug the program, test operation, and make adjustments.

- Online editing
- Monitoring I/O memory during operation
- Force-setting/force-resetting I/O bits, changing set values, and changing present values during operation

RUN Mode

The program is executed at normal speed in RUN mode. Operations such as online editing, force-setting/force-resetting I/O bits, and changing set values/present values cannot be performed in RUN mode, but the status of I/O bits can be monitored.

1-3-3 Operating Mode at Startup

The operating mode of the CPM2B-S when the power is turned ON depends upon the PC Setup settings and the Programming Console's mode switch setting if a Programming Console is connected.

PC Setup setting			Operating mode
Word	**Bits**	**Setting**	
DM 6600	08 to 15	00	See note.
		01	Startup mode is the same as the operating mode before power was interrupted.
		02	Startup mode is determined by bits 00 to 07.
	00 to 07	00	PROGRAM mode
		01	MONITOR mode
		02	RUN mode

Note The startup mode depends upon the setting of DIP Switch Pin 4 and the Programming Device connected to the peripheral port.

Programming Device	Pin 4 OFF	Pin 4 ON
None	RUN mode	PROGRAM mode
Programming Console	Operating mode set on the Programming Console's mode switch	
Other device	PROGRAM mode	

1-3-4 PC Operation at Startup

Time Required for Initialization

The time required for startup initialization depends on several factors, such as the operating conditions (including power supply voltage, system configuration, and ambient temperature) and the program contents.

Power OFF Operation

Minimum Power Supply Voltage

The PC will stop and all outputs will be turned OFF if the power supply voltage falls below 85% of the rated value.

Momentary Power Interruption

A power interruption will not be detected and CPU Board operation will continue if the power interruption lasts less than 2 ms for a DC power supply.

A power interruption may or may not be detected for power interruptions somewhat longer than 2 ms for a DC power supply.

When a power interruption is detected, the CPU Board will stop operating and all outputs will be turned OFF.

Automatic Reset

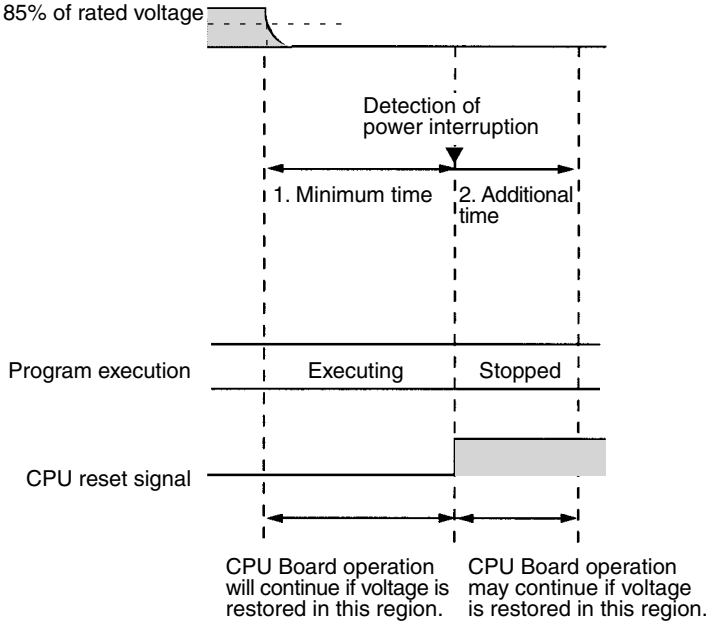
Operation will restart automatically when the power supply voltage is restored to more than 85% of the rated voltage.

Timing Chart of Power OFF Operation

The power interruption detection time is the time required for a power interruption to be detected after the power supply voltage drops below 85% of the rated value.

1,2,3...

1. Minimum power interruption detection time
   Power interruptions that are shorter than 2 ms will not be detected.
2. Undetermined additional time
   Power interruptions only slightly longer than the minimum power interruption time may not be detected.

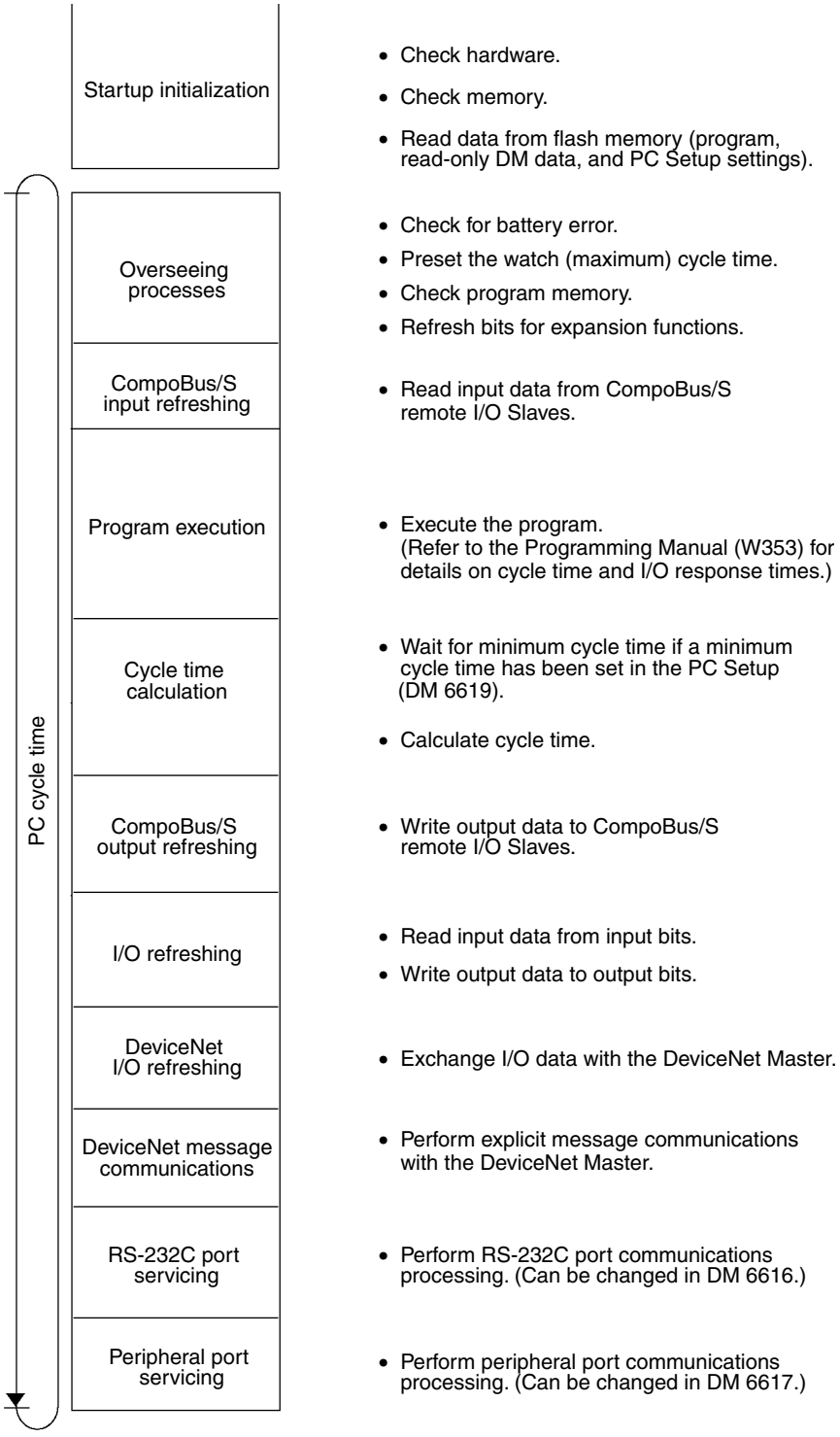

85% of rated voltage
Detection of power interruption
1. Minimum time
2. Additional time
Program execution
Executing
Stopped
CPU reset signal
CPU Board operation will continue if voltage is restored in this region.
CPU Board operation may continue if voltage is restored in this region.

Note If the power supply voltage fluctuates around 85% of the PC's rated voltage, PC operation may stop and restart repeatedly. When repeated stopping and starting will cause problems with the controlled system, set up a protective circuit such as a circuit that shuts off the power supply to sensitive equipment until the power supply voltage returns to the rated value.

1-3-5 Cyclic Operation and Interrupts

Basic CPU Operation

Initialization processing is performed when the power is turned ON. If there are no initialization errors, the overseeing processes, program execution, I/O refreshing, and communications port servicing are performed repeatedly (cyclically).


Startup initialization
• Check hardware.
• Check memory.
• Read data from flash memory (program, read-only DM data, and PC Setup settings).
PC cycle time
Overseeing processes
• Check for battery error.
• Preset the watch (maximum) cycle time.
• Check program memory.
• Refresh bits for expansion functions.
CompoBus/S input refreshing
• Read input data from CompoBus/S remote I/O Slaves.
Program execution
• Execute the program. (Refer to the Programming Manual (W353) for details on cycle time and I/O response times.)
Cycle time calculation
• Wait for minimum cycle time if a minimum cycle time has been set in the PC Setup (DM 6619).
• Calculate cycle time.
CompoBus/S output refreshing
• Write output data to CompoBus/S remote I/O Slaves.
I/O refreshing
• Read input data from input bits.
• Write output data to output bits.
DeviceNet I/O refreshing
• Exchange I/O data with the DeviceNet Master.
DeviceNet message communications
• Perform explicit message communications with the DeviceNet Master.
RS-232C port servicing
• Perform RS-232C port communications processing. (Can be changed in DM 6616.)
Peripheral port servicing
• Perform peripheral port communications processing. (Can be changed in DM 6617.)

The cycle time can be read from a Programming Device.

AR 14 contains the maximum cycle time and AR 15 contains the present cycle time in multiples of 0.1 ms.

The cycle time will vary slightly depending on the processing being performed in each cycle, so the calculated cycle time will not always match the actual cycle time.

Program Execution in Cyclic Operation

The following diagram shows the cyclic operation of the CPM2B-S when the program is being executed normally.

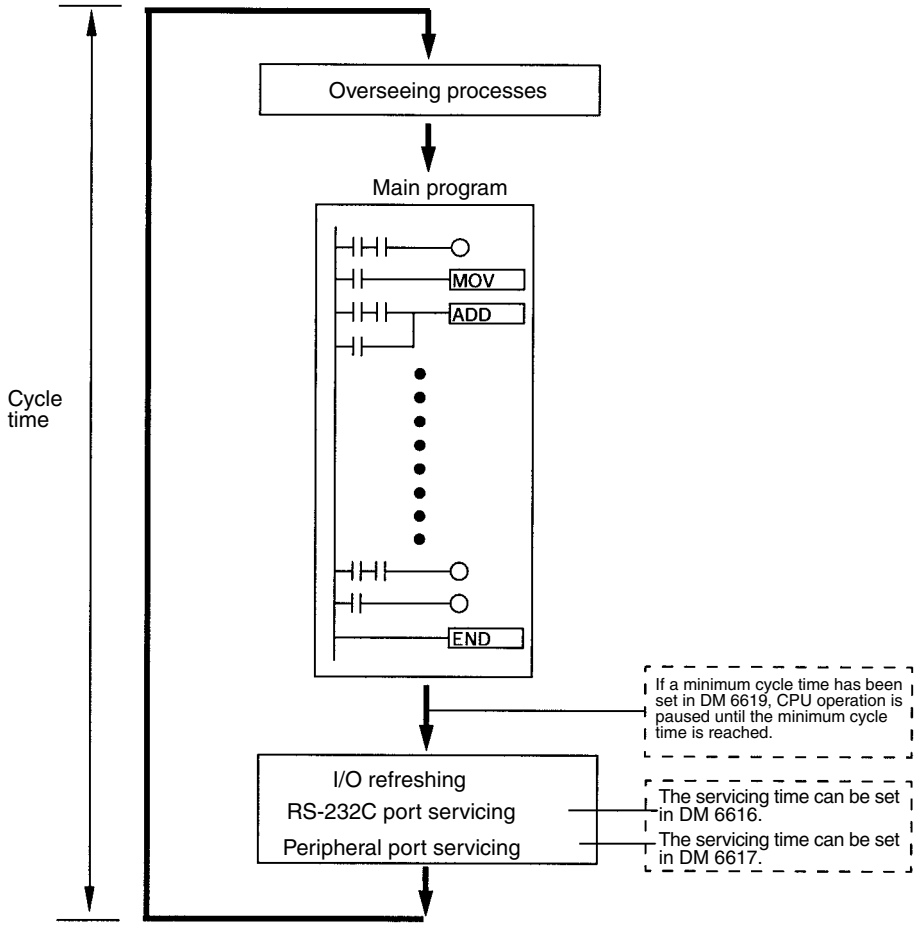
Normally, the results of program execution are transferred to I/O memory just after program execution (during I/O refreshing), but IORF(97) can be used to refresh a specified range of I/O words during program execution. The specified range of I/O words will be refreshed when IORF(97) is executed.

The cycle time is the sum of the time required for program execution, I/O refreshing, and communications port servicing.

A minimum cycle time (1 to 9,999 ms) can be set in the PC Setup (DM 6619). When a minimum cycle time has been set, CPU operation is paused after program execution until the minimum cycle time is reached. CPU operation will not be paused if the actual cycle time is longer than the minimum cycle time set in DM 6619.

Note A fatal error will occur and PC operation will stop if a maximum cycle time has been set in the PC Setup (DM 6618) and the actual cycle time exceeds that setting.

The default settings for RS-232C port servicing and Peripheral port servicing are 5% of the cycle time, but these settings can be changed (between 1% and 99%) in the PC Setup. The RS-232C port's setting is in DM 6616 and the Peripheral port's setting is in DM 6617.


Overseeing processes
Main program
MOV
ADD
END
Cycle time
If a minimum cycle time has been set in DM 6619, CPU operation is paused until the minimum cycle time is reached.
I/O refreshing
RS-232C port servicing
Peripheral port servicing
The servicing time can be set in DM 6616.
The servicing time can be set in DM 6617.

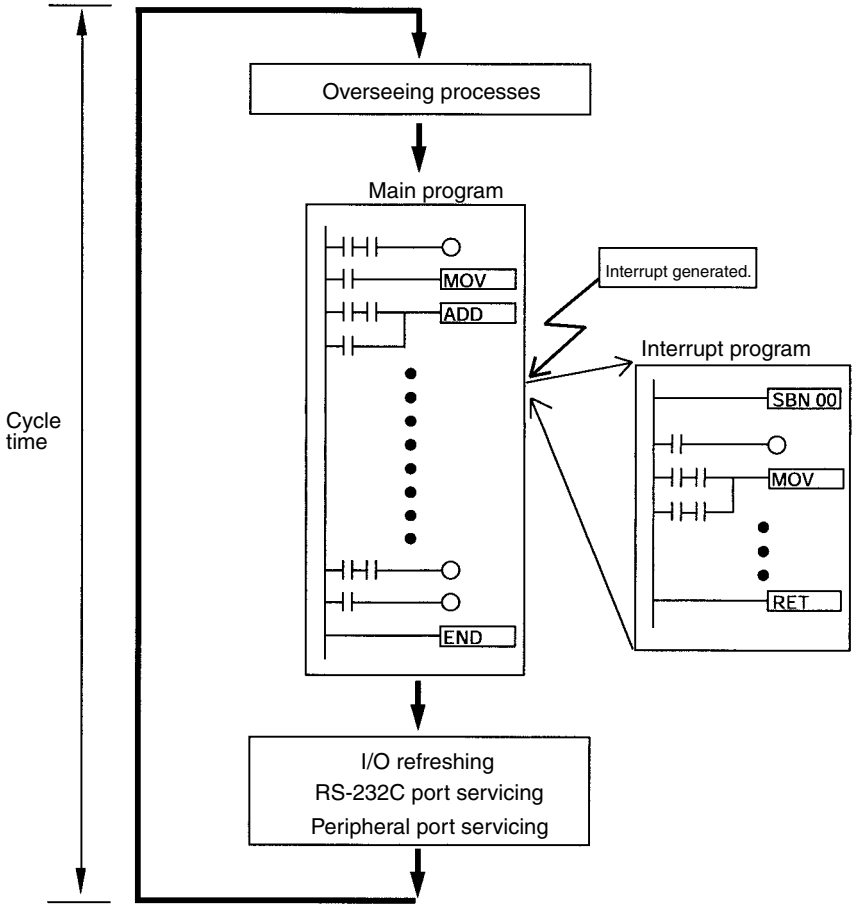
Interrupt Program Execution

When an interrupt is generated during execution of the main program, main program execution is interrupted immediately and the interrupt program is executed. The following diagram shows the cyclic operation of the CPM2B-S when an interrupt program is executed.

Normally, the results of interrupt program execution are transferred to I/O memory just after program execution (during I/O refreshing), but IORF(97) can be used to refresh a specified range of I/O words during execution of the interrupt program. The specified range of I/O words will be refreshed when IORF(97) is executed.

The normal cycle time is extended by the time required for execution of the interrupt program.

Refer to *SECTION 8 Cycle Time and I/O Response Time* for more details and precautions on the cycle time.



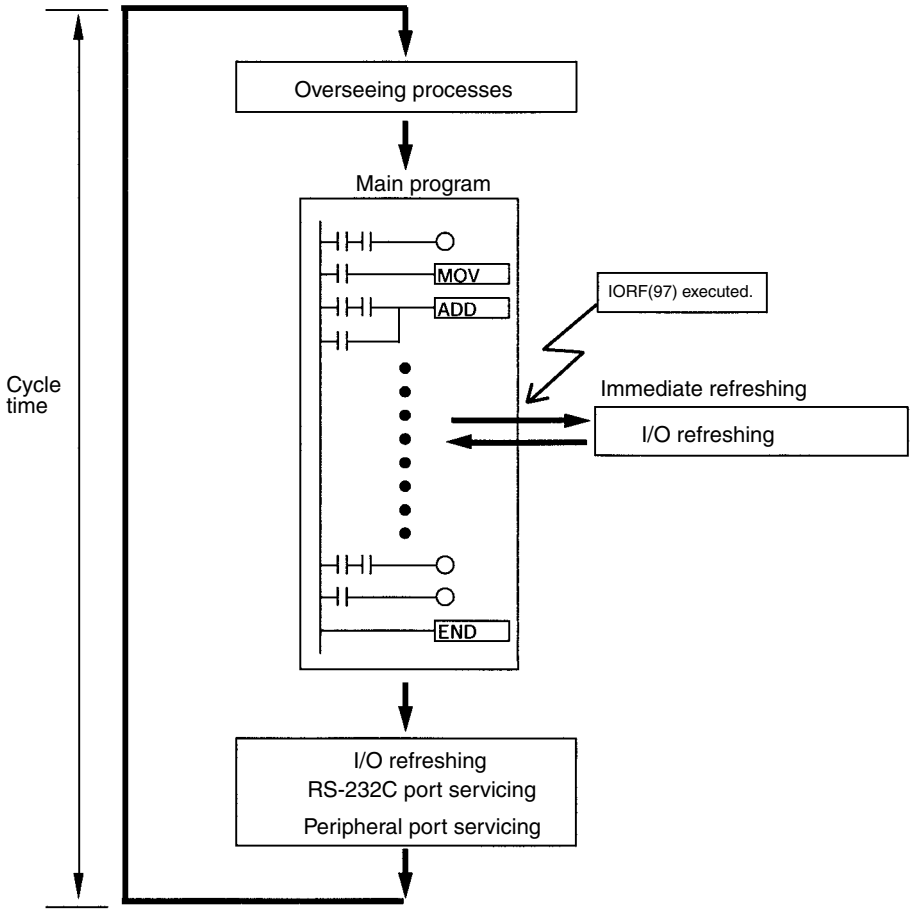
⚠ Caution Although IORF(97) can be used in interrupt subroutines, you must be careful of the interval between IORF(97) executions. If IORF(97) is executed too frequently, a fatal system error may occur (FALS 9F), stopping operation. The interval between executions of IORF(97) should be at least 1.3 ms + total execution time of the interrupt subroutine.

Immediate Refreshing

IORF(97) can be executed in the program to refresh a specified range of I/O words. The specified I/O words will be refreshed when IORF(97) is executed.

IORF(97) can be used to refresh I/O from the main program or the interrupt program.

When IORF(97) is used, the cycle time is extended by the time required to refresh the specified I/O words.



SECTION 2
Board Specifications and Components

This section provides the technical specifications of the CPM2B-S Boards and describes the main components of the Boards.

2-1 Specifications 22
2-1-1 General Specifications 22
2-1-2 Characteristics 23
2-1-3 I/O Specifications 25
2-2 Board Components and their Functions 28
2-2-1 CPU Board Components 28

2-1 Specifications

2-1-1 General Specifications

Item	CPU Boards
Supply voltage	24 V DC (Allowable range: 20.4 to 26.4 V DC)
Power consumption	4.5 W max. (CPU Board only)
Communications power supply voltage	11 to 25 V DC (Supplied from the communications connector)
Inrush current	25 A max. (CPU Board only)
Insulation resistance	20 MΩ min. (at 500 V DC) between the external DC terminals and non-current carrying metal parts
Dielectric strength	1,000 V AC 50/60 Hz for 1 min between the external DC terminals and non-current carrying metal parts
Noise immunity	Conforms to IEC6100-4-4; 2 kV (power lines)
Vibration resistance	10 to 57 Hz, 0.075-mm amplitude, 57 to 150 Hz, acceleration: 9.8 m/s^2 in X, Y, and Z directions for 80 minutes each (8 minutes of vibration × 10 repetitions= total time 80 minutes)
Shock resistance	147 m/s^2 three times each in X, Y, and Z directions
Ambient temperature	Operating: 0 to 55°C Storage: –20 to 75°C (excluding the battery)
Ambient humidity	Operating: 10% to 90% (with no condensation)
Ambient atmosphere	Operating: Must be free from corrosive gas
I/O configuration	Inputs: Connector Outputs: Connector
Power supply retention time	2 ms min.
Weight	165 g max.

Note Refer to the *CPM2B Operation Manual* (W371) for details on Expansion I/O Board specifications.

2-1-2 Characteristics

Item			CPU Boards
Control method			Stored program method
I/O control method			Cyclic scan with direct output (Immediate refreshing can be performed with IORF(97).)
Programming language			Ladder diagram
Instruction length			1 step per instruction, 1 to 5 words per instruction
Instructions	Basic instructions		14
	Special instructions		105 instructions, 185 variations
Execution time	Basic instructions		0.64 μs (LD instruction)
	Special instructions		7.8 μs (MOV instruction)
Program capacity			4,096 words
Max. I/O capacity	CPU Board only		74 points
	With Expansion I/O Boards		170 points max.
Input bits			IR 00000 to IR 00915 (Words not used for input bits can be used for work bits.)
Output bits			IR 01000 to IR 01915 (Words not used for output bits can be used for work bits.)
Work bits			928 bits: IR 02000 to IR 04915 and IR 20000 to IR 22715
Special bits (SR area)			448 bits: SR 22800 to SR 25515
Temporary bits (TR area)			8 bits (TR0 to TR7)
Holding bits (HR area)			320 bits: HR 0000 to HR 1915 (Words HR 00 to HR 19)
Auxiliary bits (AR area)			384 bits: AR 0000 to AR 2315 (Words AR 00 to AR 23)
Link bits (LR area)			256 bits: LR 0000 to LR 1515 (Words LR 00 to LR 15)
Timers/Counters			256 timers/counters (TIM/CNT 000 to TIM/CNT 255) 1-ms timers: TMHH(– –) 10-ms timers: TIMH(15) 100-ms timers: TIM 1-s/10-s timers: TIML(– –) Decrementing counters: CNT Reversible counters: CNTR(12)
CompoBus/S Master functions			Up to 32 Slaves can be connected and up to 256 I/O points can be controlled.
DeviceNet Slave functions			DeviceNet Remote I/O Link Use up to 1,024 I/O points in the I/O Link. Explicit Message Communications Any PC data area can be accessed from the Master.
Data memory	Read/Write		2,048 words (DM 0000 to DM 2047) The Error Log is contained in DM 2000 to DM 2021.
	Read-only		456 words (DM 6144 to DM 6599)
	PC Setup		56 words (DM 6600 to DM 6655)
Interrupt processing	External interrupts		2 (Also used for external interrupt inputs in counter mode and quick-response inputs.)
	Interval timer interrupts		1 (Scheduled Interrupt Mode or Single Interrupt Mode)
High-speed counter	High-speed counter		1 (20 kHz single-phase or 5 kHz two-phase (linear count method))
		Counter interrupt	1 (set value comparison or set-value range comparison)
	Interrupt Inputs (Counter mode)		2 inputs (Also used for interrupt inputs and quick-response inputs.)
		Counter interrupts	2 (Also used for the external interrupt inputs and quick-response inputs.)

Item	CPU Boards
Pulse output	2 points with no acceleration/deceleration, 10 Hz to 10 kHz each, and no direction control. 1 point with trapezoidal acceleration/deceleration, 10 Hz to 10 kHz, and direction control. 2 points with variable duty-ratio outputs. (Pulse outputs can be used with transistor outputs only, they cannot be used with relay outputs.)
Synchronized pulse control	1 point: A pulse output can be created by combining the high-speed counter with pulse outputs and multiplying the frequency of the input pulses from the high-speed counter by a fixed factor. (This output is possible with transistor outputs only, it cannot be used with relay outputs.)
Quick-response inputs	2 points (Min. input pulse width: 50 μs max.) (Also used for interrupt inputs and for interrupt inputs in counter mode.)
Input time constant (ON response time = OFF response time)	Can be set for all input points except those for IR 001 and IR 002. (1 ms, 2 ms, 3 ms, 5 ms, 10 ms, 20 ms, 40 ms, or 80 ms)
Communications functions	Built-in peripheral port: Supports Host Link, peripheral bus, no-protocol, or Programming Console connections. Built-in RS-232C port: Supports Host Link, no-protocol, 1:1 PC Link (Master/Slave), or 1:1 NT Link connections. (RS-232C communications are available only in CPU Boards equipped with an RS-232C port.)
Memory protection (See notes 1 and 2.)	HR area, AR area, program contents, read/write DM area contents, and counter values maintained during power interruptions.
Memory backup (See notes 1 and 2.)	Flash memory: Program, read-only DM area, and PC Setup Battery or capacitor backup: The read/write DM area, HR area, AR area, and counter values are backed up by a battery. • Backup time without a battery (optional) is approximately 10 days at 25°C. • Backup time with a battery (optional) connected is approximately 5 years at 25°C.
Self-diagnostic functions	CPU error (watchdog timer), I/O bus error, battery error, and memory error
Program checks	No END instruction, programming errors (checked when operation is started)

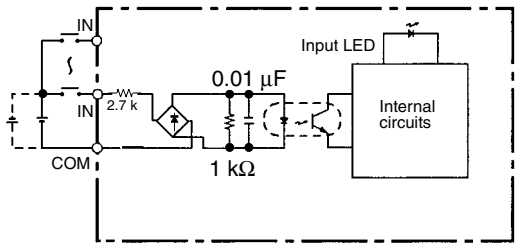
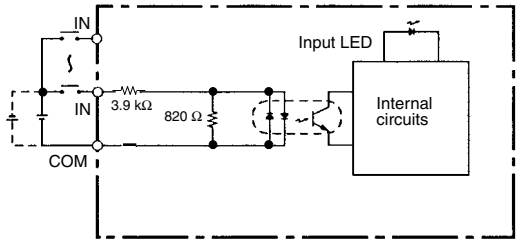
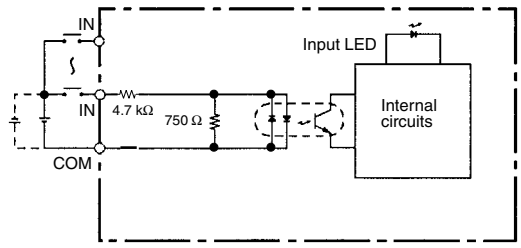
Note

1. The DM area, HR area, AR area, and counter values are backed up by the battery or capacitor on the CPU Board. If the battery or capacitor is discharged, the contents of these areas will be lost and the data values will revert to the defaults.
2. The contents of the program area, read-only DM area (DM 6144 to DM 6599), and PC Setup (DM 6600 to DM 6655) are stored in flash memory. The contents of these areas will be read from flash memory the next time the power is turned ON, even if the backup battery or capacitor is discharged.

   When data has been changed in any of these areas, write the new values to flash memory by switching the CPM2B-S to MONITOR or RUN mode, or by turning the power OFF and then ON again.

2-1-3 I/O Specifications

CPU Board Input Specifications (For the Input Connector and I/O Connector)

Item	Inputs	Specification
Input voltage	All	24 V DC $^{+10\%}/_{-15\%}$
Input impedance	IN00000 to IN00001	2.7 kΩ
	IN00002 to IN00004	3.9 kΩ
	IN00005 IN00100 to IN00115 IN00200 to IN00215	4.7 kΩ
Input current	IN00000 to IN00001	8 mA typical
	IN00002 to IN00004	6 mA typical
	IN00005 IN00100 to IN00115 IN00200 to IN00215	5 mA typical
ON voltage/current	IN00000 to IN00001	17 V DC min., 5 mA
	IN00002 to IN00005 IN00100 to IN00115 IN00200 to IN00215	14.4 V DC min., 3.5 mA
OFF voltage/current	All	5.0 V DC max., 1.1 mA
ON delay	All	1 to 80 ms max. Default: 10 ms (See note.)
OFF delay	All	1 to 80 ms max. Default: 10 ms (See note.)
Circuit configuration	IN00000 to IN00001	
	IN00002 to IN00004	
	IN00005 IN00100 to IN00115 IN00200 to IN00215	

Note The input time constant can be set to 1, 2, 3, 5, 10, 20, 40, or 80 ms in the PC Setup. See page 76.

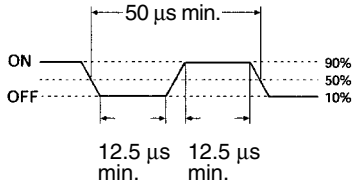
High-speed Counter Inputs

Inputs IN00000 through IN00002 can be used as high-speed counter inputs, as shown in the following table. The maximum count frequency is 5 kHz in differential phase mode and 20 kHz in the other modes.

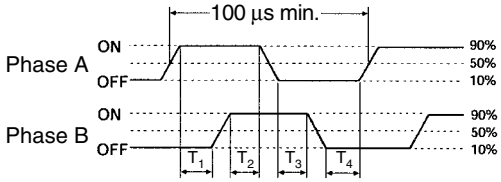
Input	Function			
	Differential phase mode	Pulse plus direction input mode	Up/down input mode	Increment mode
IN00000	A-phase pulse input	Pulse input	Increment pulse input	Increment pulse input
IN00001	B-phase pulse input	Direction input	Decrement pulse input	Normal input
IN00002	Z-phase pulse input or hardware reset input (IN00002 can be used as a normal input when it is not used as a high-speed counter input.)			

The minimum pulse widths for inputs IN00000 (A-phase input) and IN00001 (B-phase input) are as follows:

Pulse plus direction input mode, Up/down input mode, Increment mode

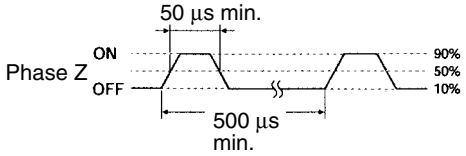


Differential phase mode



$T_1 T_2 T_3 T_4$: 12.5 μs min.

The minimum pulse width for input IN00002 (Z-phase input) is as follows:



Interrupt Inputs

Inputs IN00003 through IN00006 can be used as interrupt inputs (interrupt input mode or counter mode) and quick-response inputs. The minimum pulse width for these inputs is 50 μs.

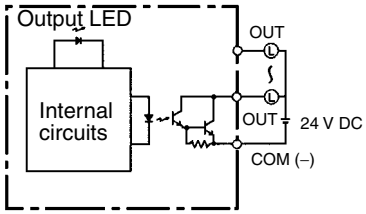
Expansion I/O Board Input Specifications

Refer to the *CPM2B Operation Manual* (W371) for details on Expansion I/O Board input specifications.Expansion I/O Board Input Specifications

CPU Board Output Specifications

The following specifications apply to outputs in both the output connector and I/O connector. The CPU Board's outputs are transistor outputs.

Item	Specification	
Max. switching capacity	OUT01000 and OUT01001: OUT01002 and OUT01003: OUT01100 to OUT01115 OUT01200 to OUT01215	4.5 to 30 V DC, 0.2 A/output (See note 1.) 4.5 to 30 V DC, 0.3 A/output (See note 1.)
Leakage current	0.1 mA max.	
Residual voltage	1.5 V max.	
ON delay	OUT01000 and OUT01001: OUT01002 and OUT01003: OUT01100 to OUT01115 OUT01200 to OUT01215	20 μs max. 0.1 ms max.

Item	Specification	
OFF delay	OUT01000 and OUT01001:	40 μs max. for 4.5 to 26.4 V, 10 to 100 mA 0.1 ms max. for 4.5 to 30 V, 10 to 200 mA
	OUT01002 and OUT01003: OUT01100 to OUT01115 OUT01200 to OUT01215	1 ms max. for 4.5 to 30 V, 10 to 300 mA.
Fuse	1 fuse/output (cannot be replaced by user)	
Circuit configuration	**Sinking Outputs** 	

Note

1. When using OUT01000 or OUT01001 for pulse outputs, connect a dummy resistor as required to bring the load current between 0.01 and 0.1 A. If the load current is below 0.01 A, the ON-to-OFF response time will be too long and high-speed pulses will not be output.
2. The specifications and circuit configuration are the same for the output connector's outputs (OUT01100 to OUT01215).

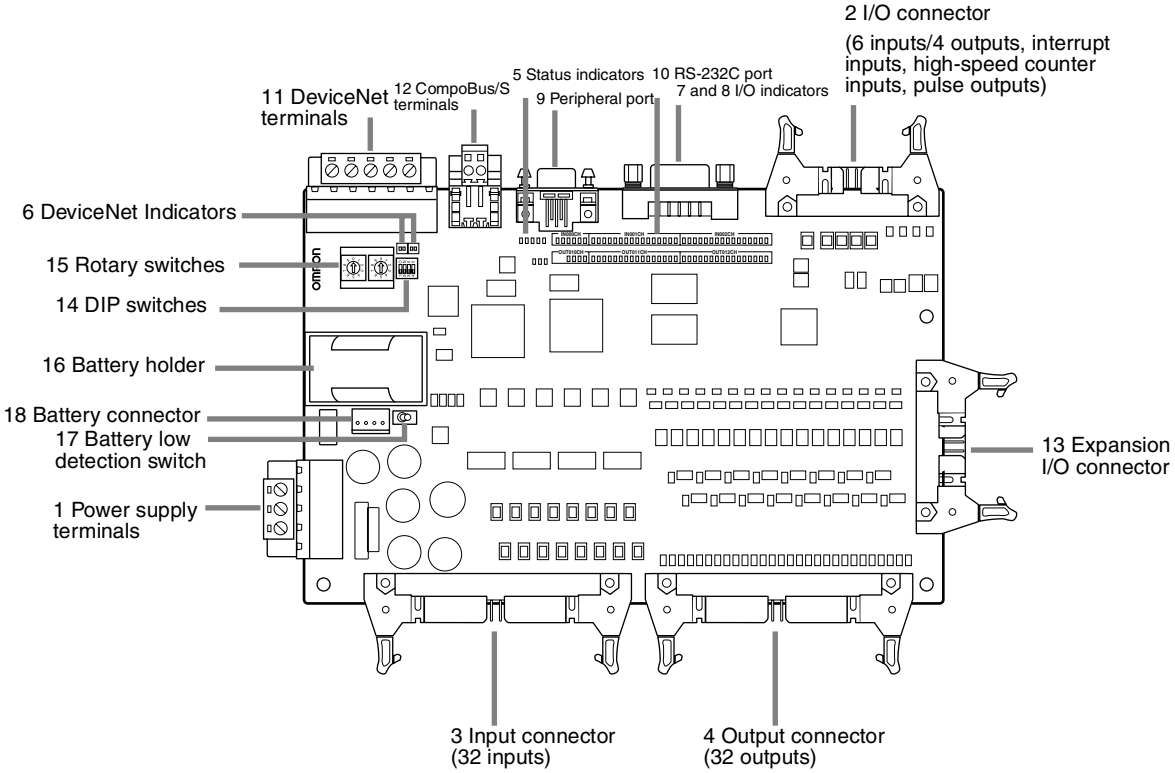
OUT01100 to OUT01115 OUT01200 to OUT01215	The switching capacity for the output connector's outputs is 0.3 A/output, but the maximum current per common is 1A. Do not exceed 1 A/common.

⚠ **Caution** Do not apply voltage in excess of the maximum switching capacity to an output terminal. It may result in damage to the product or fire.

2-2 Board Components and their Functions

2-2-1 CPU Board Components

CPU Boards



CPU Board Component Descriptions

1,2,3...

1. Power Supply Terminals
   Connect the power supply (24 V DC) to these terminals.
2. I/O Connector
3. Input Connector
   Connects the CPU Board to external input devices.
4. Output Connector
   Connects the CPU Board to external output devices.
5. Status Indicators
   These indicators show the operating status of the PC, as shown in the following table.

Indicator	Status	Meaning
PWR (green)	ON	Power is being supplied to the PC.
	OFF	Power isn't being supplied to the PC.
RUN (green)	ON	The PC is operating in RUN or MONITOR mode.
	OFF	The PC is in PROGRAM mode or a fatal error has occurred.
ERR/ALM (red)	ON	A fatal error has occurred. (PC operation stops.)
	Flashing	A non-fatal error has occurred. (PC operation continues.)
	OFF	Indicates normal operation.
COMM (yellow)	Flashing	Data is being transferred via the communications port (peripheral or RS-232C).
	OFF	Data isn't being transferred via communications port.

Indicator	Status	Meaning
PERI (yellow)	ON	Data is being transferred via the peripheral port.
	OFF	The peripheral port is not being used.
RD (yellow)	Flashing	Data is being received via CompoBus/S.
	OFF	Data isn't being received via CompoBus/S.
SD (yellow)	Flashing	Data is being transmitted via CompoBus/S.
	OFF	Data isn't being transmitted via CompoBus/S.
ERC (red)	Flashing	A CompoBus/S communications error occurred.
	OFF	A CompoBus/S communications error hasn't occurred.

6. DeviceNet Indicators

The following indicators show the status DeviceNet communications.

Indicator	Color	Status	Meaning
MS	Green	ON	Normal status
		Flashing	Incomplete settings (reading switch settings)
	Red	ON	Fatal hardware error (watchdog timer error)
		Flashing	Non-fatal error such as incorrect switch settings
	---	OFF	• Power is not being supplied. • Waiting for initialization to start • Reset in progress
NS	Green	ON	Online/Communications established (Normal network status when communications have been established)
		Flashing	Online/Communications not established (Normal network status when communications haven't been established)
	Red	ON	Fatal communications error (The Unit detected an error indicating that network communications are disabled.) • Node number duplication • Bus off error detected
		Flashing	Non-fatal communications error (Communications timeout)
	---	OFF	Offline/Power supply OFF Waiting for completion of the node number duplication check in the Master. • Incorrect switch settings • Power supply OFF

7. Input Indicators

The input indicators are lit when the corresponding input terminal is ON. The status of an input indicator will reflect the status of the input even when that input is being used for a high-speed counter.

Note a) When interrupt inputs are used in interrupt input mode, the indicator may not light even when the interrupt condition is met if the input is not ON long enough. When a high-speed counter is being used, the indicator may not light depending on the speed of the pulses.

b) Input indicators will reflect the status of the corresponding inputs even when the PC is stopped, but the corresponding input bits will not be refreshed.

8. Output Indicators

   The output indicators are lit when the corresponding output terminal is ON. The indicators are lit during I/O refreshing. When an output is being used as a pulse output, the corresponding will remain lit while pulses are being output.

9. Peripheral Port

   Connects the PC to a Programming Device (including Programming Consoles), host computer, or standard external device.

10. RS-232C Port

    Connects the PC to a Programming Device (excluding Programming Consoles), host computer, Programmable Terminal, or standard external device.

11. DeviceNet Terminals

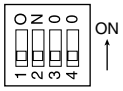
12. CompoBus/S Terminals

13. Expansion I/O Connector

    Connects the CPU Board to an Expansion I/O Board. Up to 3 Expansion I/O Boards can be connected to a CPU Board.

14. DIP Switch

    The DIP switch settings determine the DeviceNet communications speed and control the communications settings for the communications port (peripheral port and RS-232C port).



- DeviceNet communications speed

Pin 1	Pin 2	Speed	Max. transmission line length (see note)
OFF	OFF	125 kbps	500 m max.
ON	OFF	250 kbps	250 m max.
OFF	ON	500 kbps	100 m max.
ON	ON	Not used (invalid setting)	

- RS-232C and Peripheral Port Settings

Pin 3	Effective port settings
OFF	The ports operate according to the settings in the PC Setup. RS-232C port settings: DM 6645 to DM 6649 Peripheral port settings: DM 6650 to DM 6654
ON	The ports operate with the standard communications settings.

- Operating Mode at Startup

  Pin 4 determines the operating mode at startup only if there isn't a Programming Device connected to the peripheral port.

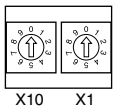
Programming Device connected	Startup mode with pin 4 OFF	Startup mode with pin 4 ON
None	RUN mode	PROGRAM mode
Programming Console	Operating mode set on the Programming Console's mode switch	
Other device	PROGRAM mode	

Note a) All four fins are set to OFF when the Board is shipped.

b) Always turn OFF the power supply before changing DIP Switch settings. When changing pin settings, use an insulated tool that has a fine tip such as a precision screwdriver with a plastic handle.

15. Rotary Switches

    The rotary switches set the PC's node number in the DeviceNet network. The allowed setting range is 00 to 63. (Settings 64 to 99 are not allowed.)

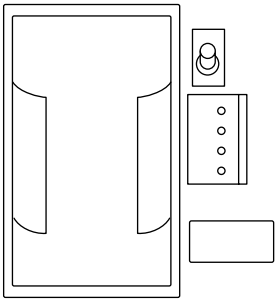


16. Battery Holder

    The battery backs up memory in the CPU Board.

17. Low Battery Detection Switch

    This switch enables or disables the detection of a low-battery error. When a battery is not connected, disable low-battery error detection by turning this switch OFF.



Setting	Function
OFF	Disables low-battery error detection.
ON	Enables low-battery error detection.

Note

1. The low-battery detection switch is set to OFF when the Board is shipped because a battery is not included with the Board when it is shipped. If a C500-BAT08 Battery Unit has been purchased separately and connected, enable low-battery detection by turning ON the low-battery detection switch.
2. A low battery will be detected only when this switch is turned ON and bits 12 to 15 of DM 6655 are set to 0. If a low battery is detected, SR 25308 will turn ON and an error will occur.

SECTION 3
Installation and Wiring

This section provides information on installing and wiring a CPM2B-S PC. Be sure to follow the directions and precautions in this section when installing the CPM2B-S in a panel or cabinet, wiring the power supply, or wiring I/O.

3-1 Design Precautions 34
3-1-1 Power Supply Wiring 34
3-1-2 Power Supply Voltage 34
3-1-3 Interlock and Limit Circuits 34
3-2 Selecting an Installation Site 35
3-2-1 Installation Site Conditions 35
3-2-2 Panel/Cabinet Installation 35
3-3 Assembling the CPM2B-S Boards 36
3-4 Installing the CPM2B-S 38
3-5 Wiring and Connections 39
3-5-1 Power Supply Wiring 40
3-5-2 I/O Wiring Procedures 41
3-5-3 Wiring CompoBus/S Transmission Lines 51
3-5-4 Wiring DeviceNet Communications Cables 53
3-5-5 Connecting a Programming Device to the Peripheral Port 54
3-5-6 Connecting to the RS-232C Port 55

3-1 Design Precautions

Observe the following precautions when designing a system incorporating a CPM2B-S PC.

3-1-1 Power Supply Wiring

Separate the power supply wiring from the power system, control system, CPM2B-S system, and DC I/O system wiring. Separate the control circuits that supply power to the main Unit from the main circuits using dedicated circuit protectors and fuses.

3-1-2 Power Supply Voltage

⚠ **Caution** Use the power supply voltages indicated in *Section 2-1 Specifications*. Failure to adhere to the specifications may result in fire.

If the power supply voltage falls below 85% of the rated voltage, the CPM2B-S will stop and all outputs will be turned OFF. If low voltage affects the equipment, etc., provide a protection circuit which shuts off the output until the supply voltage returns to the rated value.

In places where power supply conditions are poor, take steps to ensure that power is supplied at the rated voltage. Be sure to adhere to safety precautions, such as providing breakers to prevent short circuits in external wiring.

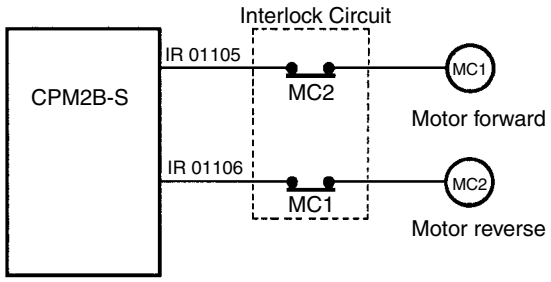
When conducting any of the following operations, turn OFF the power to the PC. Electrocution, product damage and malfunction may result.

- Connecting or disconnecting Expansion I/O Boards and CPU Boards.
- Assembling equipment.
- Connecting cables and wiring.

3-1-3 Interlock and Limit Circuits

⚠ **WARNING** Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided in external control circuits (i.e., not in the Programmable Controller) to ensure safety in the system if an abnormality occurs due to malfunction of the PC or another external factor affecting the PC operation. Not providing proper safety measures may result in serious accidents.

The following diagram shows an example of an interlock circuit.



In the interlock circuit above, MC1 and MC2 can't be ON at the same time even if CPM2B-S outputs IR 01105 and IR 01106 are both ON (an incorrect PC operation).

3-2 Selecting an Installation Site

The CPM2B-S is resistant to harsh conditions and highly reliable, but installing the PC in a favorable site will maximize its reliability and operating lifetime.

⚠ **Caution** Be sure to install the CPM2B-S correctly, as outlined in this manual. Failure to do so may result in Board malfunction.

3-2-1 Installation Site Conditions

Note Do not install the CPM2B-S under any of the following conditions.

- Locations subject to direct sunlight.
- Locations subject to an ambient temperature below 0°C or over 55°C.
- Locations subject to an ambient humidity below 10% or over 90%.
- Locations subject to condensation as the result of severe changes in temperature.
- Locations subject to corrosive or flammable gases.
- Locations subject to dust (especially iron dust) or salts.
- Locations subject to shock or vibration.
- Locations subject to exposure to water, oil, or chemicals.

Be sure that the conditions at the installation site conform to the CPM2B-S's general specifications. Refer to *2-1-1 General Specifications* for details.

Note Provide proper shielding when installing in the following locations:

- Locations subject to static electricity or other sources of noise.
- Locations subject to strong electromagnetic fields.
- Locations subject to possible exposure to radiation.
- Locations near to power supply lines.

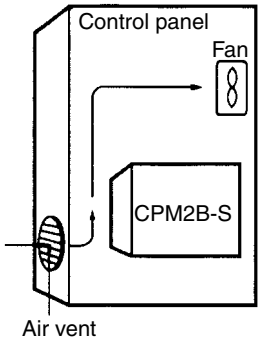
3-2-2 Panel/Cabinet Installation

Consider PC operation, maintenance, and surrounding conditions when installing the CPM2B-S in a panel or cabinet.

Overheating

The ambient operating temperature range for the CPM2B-S is 0°C to 55°C. Be sure that there is adequate ventilation for cooling.

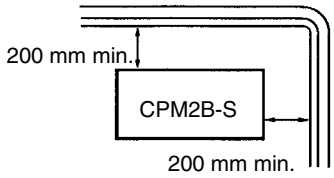
- Allow enough space for air circulation.
- Do not install the CPM2B-S above equipment that generates a large amount of heat, such as heaters, transformers, or large resistors.
- Install a cooling fan or system when the ambient temperature exceeds 55°C.



Electrical Noise

Power lines and high-voltage equipment can cause electrical noise in the PC.

- Do not install the CPM2B-S in a panel or cabinet with high-voltage equipment.
- Allow at least 200 mm between the CPM2B-S and nearby power lines.



Accessibility

Ensure that the CPM2B-S can be accessed for normal operation and maintenance. High-voltage equipment, power lines, and moving machinery could be dangerous if they are in the way during routine operations.

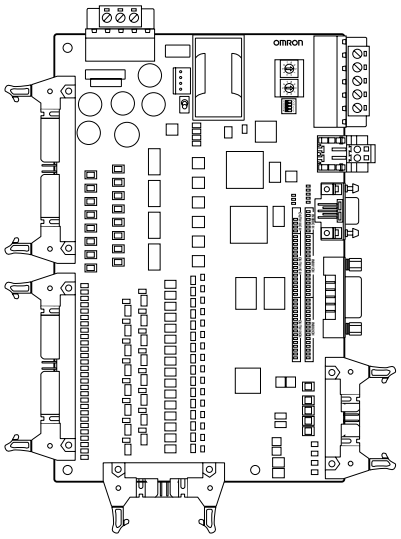
3-3 Assembling the CPM2B-S Boards

Board Assembly

Up to 3 Expansion I/O Boards can be connected to a CPM2B-S CPU Board. The following diagram shows how to assemble the Boards. The screws and standoffs are included with the CPU Board, Expansion I/O Board, and Mounting Bracket.

The CPM2B-S Boards can be installed in any direction, but the maximum ambient operating temperature is 50°C instead of 55°C if the Boards are installed with the power supply terminals up.

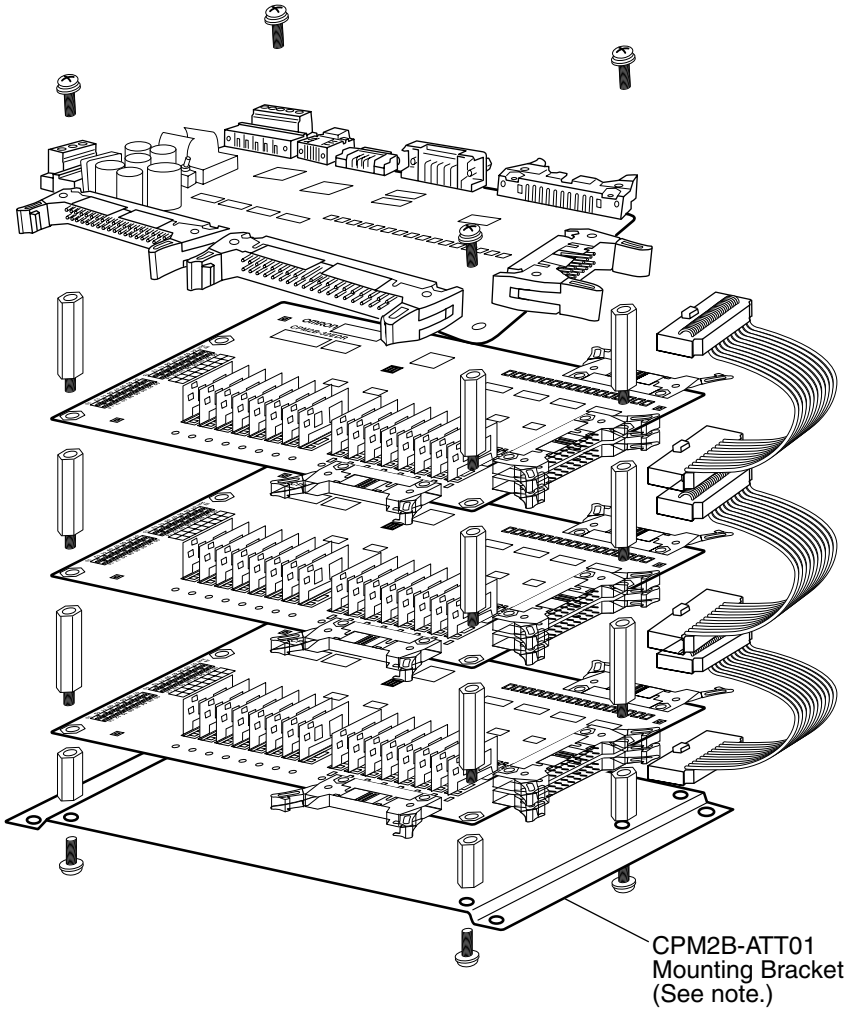
Up



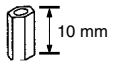
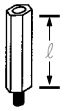
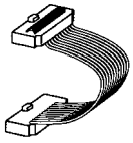
Down

Note

1. Use M3 screws for the standoffs and tighten to a torque of 0.5 N•m.
2. When using an Expansion I/O Board, refer to the *CPM2B Operation Manual* (W371) for information on the installation directions, the number of inputs that can be ON simultaneously, and the affects of ambient temperature.



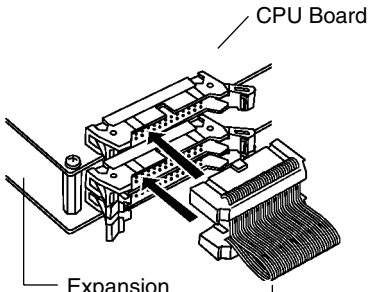
Note The CPM2B-ATT01 Mounting Bracket is required when the system must meet UL/CSA standards.

Board or Bracket	Hardware and cables included
CPU Board	Four M3 standoffs (short)  Four M3 screws
Expansion I/O Board	Four M3 standoffs (long) ℓ =26 mm  One CPM2B-CN601 Expansion I/O Cable (Cable length = 60 mm) 
Mounting Bracket	Four M3 screws

Note Some of the CPM2B-S's electrical components such as leads are sharp, so do not touch the components or the surface of the circuit board.

Installing the Expansion I/O Connecting Cables

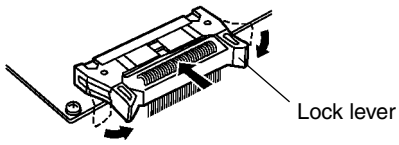
1,2,3... 1. Insert the Expansion I/O Cable into the connectors on the CPU Board and Expansion I/O Board.



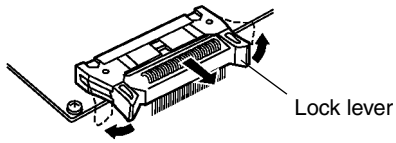
The cable from the CPU Board connects to the upper Expansion I/O Connector (the one with the short locks.)

Install the shorter connector of the cable in the lower Board and the longer connector in the upper Board.

2. Push the cable's connector into the Board's connector until both lock levers lock solidly.

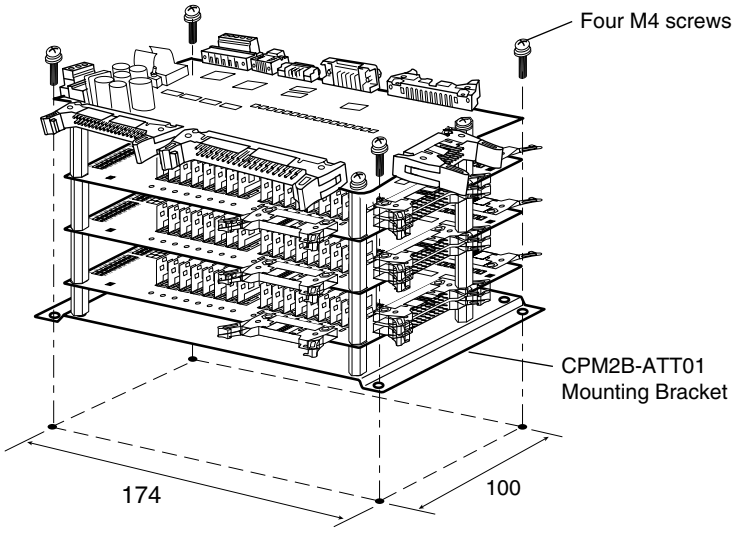


To remove the Expansion I/O Cable, open the connectors lock levers and pull out the cable's connector.

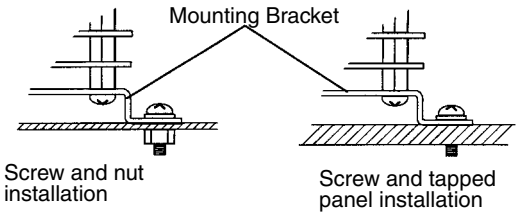


3-4 Installing the CPM2B-S

Install the CPM2B-S as shown in the following diagram. The CPM2B-S cannot be installed on DIN Track.

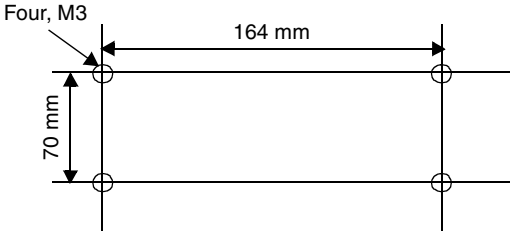


Example Installations



Note

1. When attaching the Mounting Bracket, use M4 screws and tighten to a torque of 1.2 N•m.
2. The CPM2B-S can be installed without a CPM2B-ATT01 Mounting Bracket. When a Mounting Bracket is not being used, prepare the panel as shown in the following diagram.
   Use M3 screws to attach to the panel and tighten to a torque of 0.5 N•m.



3. Installing the CPM2B-S horizontally or with its narrow edge down affects cooling and limits the number of inputs that can be ON simultaneously at high temperatures. Refer to page 26 for details.

3-5 Wiring and Connections

This section provides basic information on power supply wiring and I/O wiring.

General Precautions for Wiring

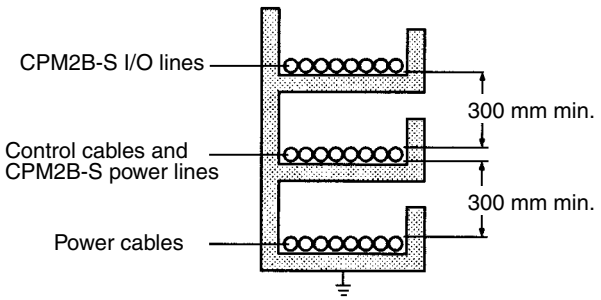
⚠ **Caution** Cover the CPM2B-S Boards with plastic or use some other method to prevent strands of wire from getting on the Board or inside the Board's components during wiring. Wire strands may short circuit the Board's components.

I/O Line Noise

Do not run CPM2B-S I/O lines in the same duct or conduit as power lines.

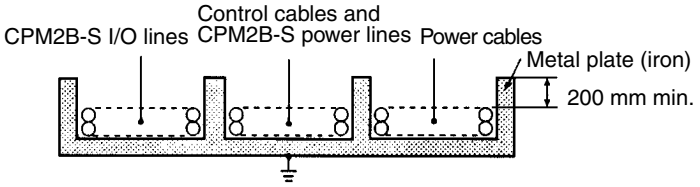
Hanging Ducts

Leave at least 300 mm between the power cables and the I/O or control wiring, as shown in the following diagram.



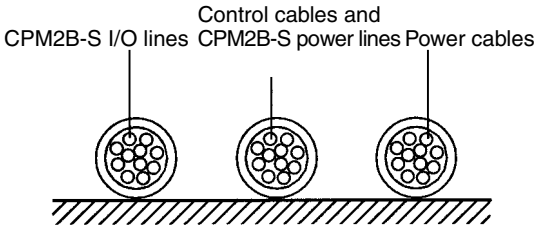
Floor Ducts

Leave at least 200 mm between the wiring and the top of the duct, as shown in the following diagram.



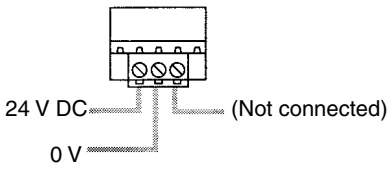
Conduits

Separate the CPM2B-S I/O lines, power and control lines, and power cables, as shown in the following diagram.



3-5-1 Power Supply Wiring

The power supply terminal specifications are shown below. Supply the power supply terminals with 24 V DC.



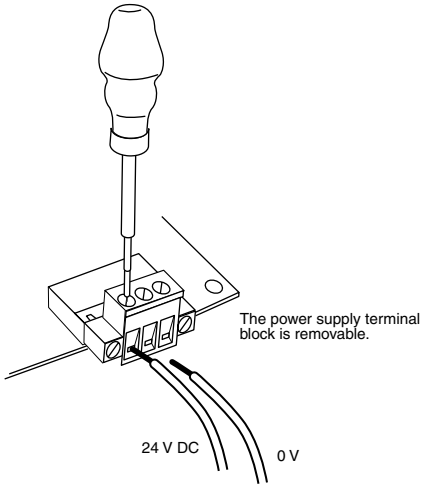
Terminal Specifications

Item	Specifications
Screw size	M3
Recommended torque	0.5 to 0.6 N•m Recommended screwdriver: OMRON XW4E-00C

Compatible Wires and Terminals

Wire/terminal		Specification
Solid wire		0.2 to 2.5 mm^2 (AWG 24 to AWG 12) Strip 7 mm (1/4 inch) of insulation.
Stranded wire		0.2 to 2.5 mm^2 (AWG 24 to AWG 12) Strip 7 mm (1/4 inch) of insulation.
Two-conductor wires	Solid	2 × (0.2 to 1.0 mm^2) (AWG 24 to AWG 20)
	Stranded	2 × (0.2 to 1.5 mm^2) (AWG 24 to AWG 16)
	Stranded with pin terminal	2 × (0.25 to 1.0 mm^2) (AWG 24 to AWG 20) without an insulating sleeve
Pin terminals		0.2 to 2.5 mm^2 diameter, 7-mm long pin terminal

The following diagram shows how to wire the power supply.

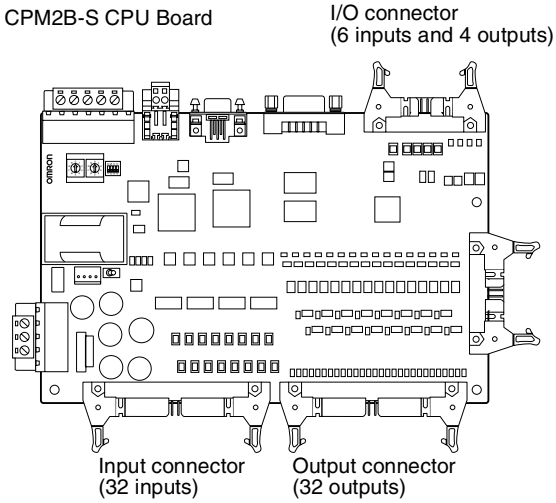


Note Do not perform a voltage withstand test on the DC power supply terminals. The test might damage the PC's internal components.

3-5-2 I/O Wiring Procedures

Removing and Wiring I/O Terminal Blocks

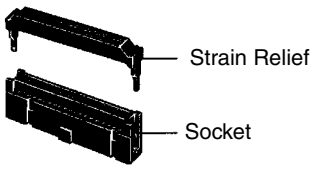
The output terminal specifications are provided below.



Removing and Wiring I/O Connectors

The following tables provide specifications of compatible OMRON I/O connectors.

MIL Flat Cable Connector



Note The max. rated current for flat cable is 1 A. Be sure that the current at the common terminal does not exceed 1A.

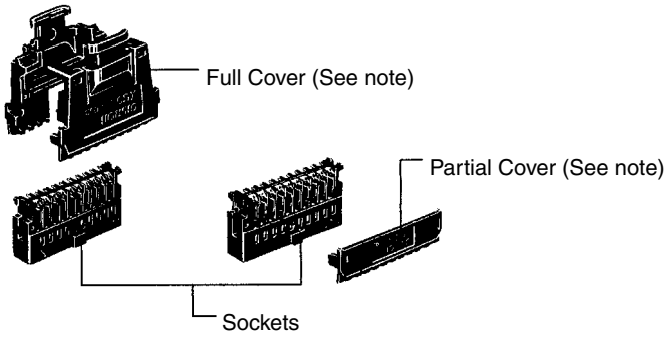
Available Connectors and Cables

Name	Model number
Socket	XG4M-2030
Strain Relief	XG4T-2004
Set (Socket + Strain Relief)	XG4T-2030-T
Recommended Flat Cable	XY3A-200□

OMRON Crimping Tools

Crimping Tool	XY2B-0002
Attachment	XY2B-1007

MIL Loose-wire Pressure Connector



Note Two Full Covers or Partial Covers are required for each socket.

Available Connectors

Name		Model number
Socket	AWG 24	XG5M-2032-N
	AWG 26 to 28	XG5M-2035-N
Full Cover (2 required for each Socket)		XG5S-2012
Partial Cover (2 required for each Socket)		XG5S-1001

OMRON Pressing Tools

Pressing Tool Set (Handy Press)	XY2B-2104
Simple Pressing Tool	XY2B-7006

Using Relay Terminal and Terminal Blocks

A G79-A□C (Loose-wire Connecting Cable) can be used to connect to a Relay Terminal. (A pressure connector must be attached on the PC side of the cable.)

A special cable is not provided for connection to the XW2B-20G4 or XW2B-20G5 Terminal Blocks, so one must be made. (The Terminal Block requires the kind of MIL 20P connector described above.)

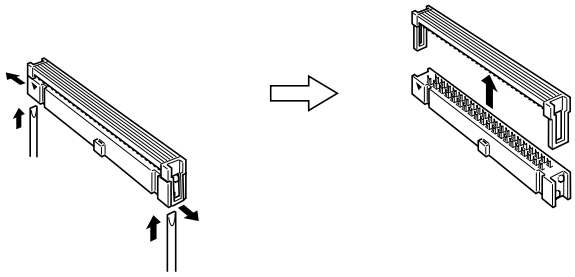
Assembling and Wiring Input Connectors and Output Connectors

MIL40 Flat Cable Connector

Follow this procedure when assembling your own connecting cable using flat cable and XG4M-4030-T MIL Connectors.

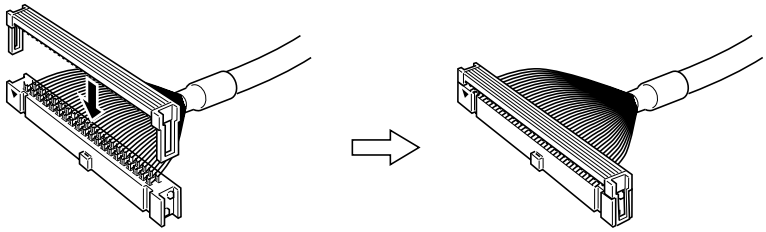
1,2,3... 1. Use a slotted precision screwdriver to release the hooks on the sides of the connector and separate the MIL socket's contact and cover pieces. There are two tabs on each side of the socket (contact piece). Do not try

to completely remove just one side at a time. Remove the hooks from just one tab on both sides of the connector and then remove the cover.

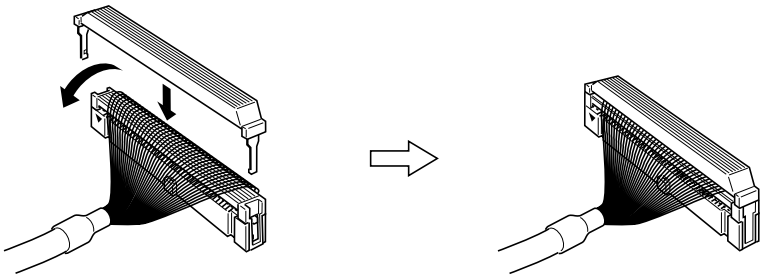


2. Insert the flat cable's wires into the socket that was separated in step 1, align the positions of the wires with the contacts, and lock the contact and cover pieces together.

   Use a vise or other tool to press the pieces together until the hook engages firmly on the connector's bottom tab.
   Compatible cables: 1.27 mm pitch flat cable with 28 AWG 7-conductor stranded wires
   UL2651 (standard cable)
   UL20012 (ribbon cable)
   UL20028 (color coded cable)



3. When necessary fold over the cable, install a strain relief, and lock it in place.



4. Connect the assembled MIL connector to an I/O Terminal.

MIL40P Loose-wire Pressure Connection

If you are assembling your own connecting cable with loose wire, assemble the connectors with the parts listed in the following table. Select the proper parts for the wire gauge being used.

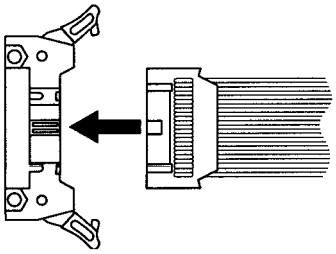
Part	For 24 AWG wire	For 28 or 26 AWG wire
Socket	XG5M-4032-N	XG5M-4035-N
Partial Cover	XG5S-2001 (See note a.)	
Hood Cover	XG5S-5022 (See note b.)	

Note a) Two Partial Covers are required for each Connector.

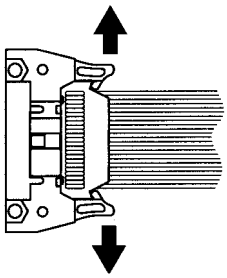
b) When a Hood Cover is being used, a multi-drop wiring DeviceNet connector cannot be used.

Inserting and Removing I/O Connectors

When inserting a cable, first open the lock levers on each side of the connector and then insert the cable's connector. Press the cable's connector firmly until both lock levers lock onto the connector.



To remove the cable, open the lock levers to the left and right before removing the cable's connector.



Wire inputs to the CPM2B-S CPU Board and Expansion I/O Boards as shown in the following diagrams.

Note Refer to the *CPM2B Operation Manual* (W371) for details on wiring inputs to Expansion I/O Boards.

3-5-2-1 CPU Board I/O Connector Wiring

Wire the CPU Board's I/O Connector (6 inputs and 4 outputs) as shown in the following diagram.

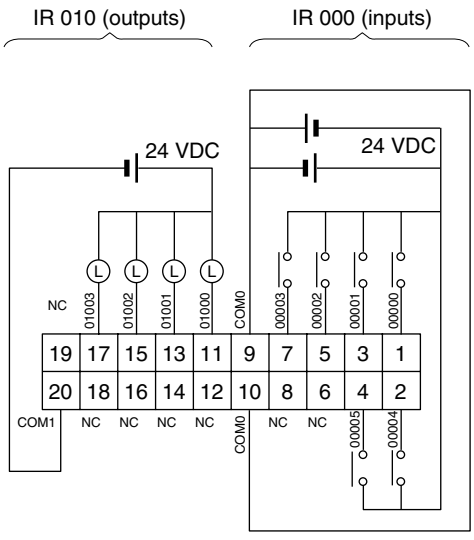


Diagram shows connector on the Board as viewed from the side from which the external connector is inserted.

3-5-2-2 CPU Board Input Connector Wiring

Wire the CPU Board's Input Connector (32 inputs) as shown in the following diagram.

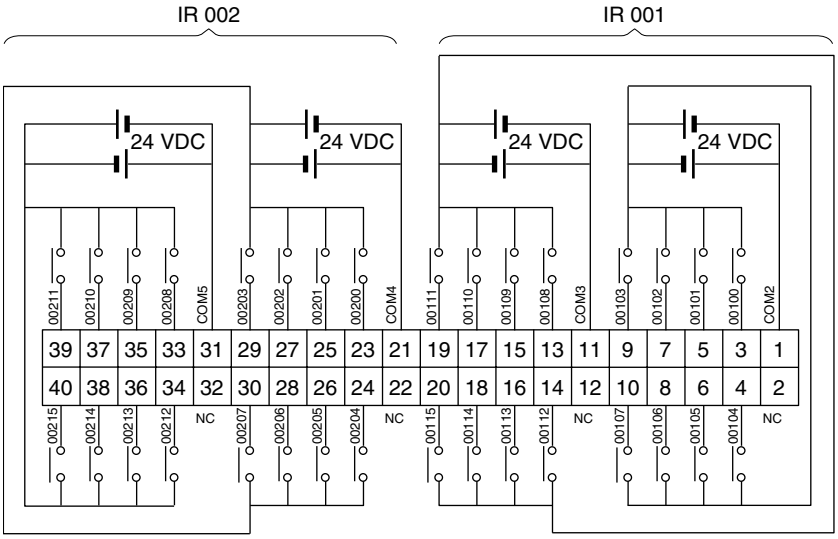


Diagram shows connector on the Board as viewed from the side from which the external connector is inserted.

3-5-2-3 CPU Board Output Connector Wiring

Wire the CPU Board's Output Connector (32 outputs) as shown in the following diagram.

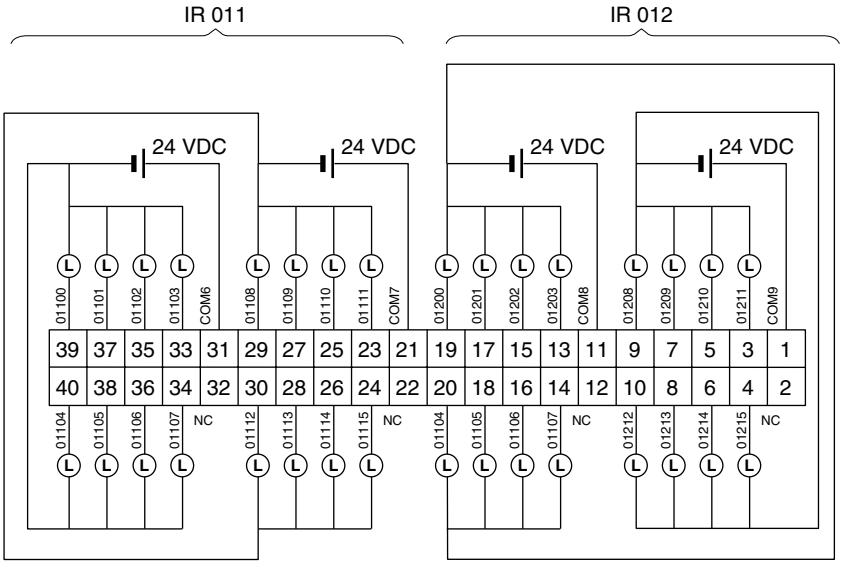
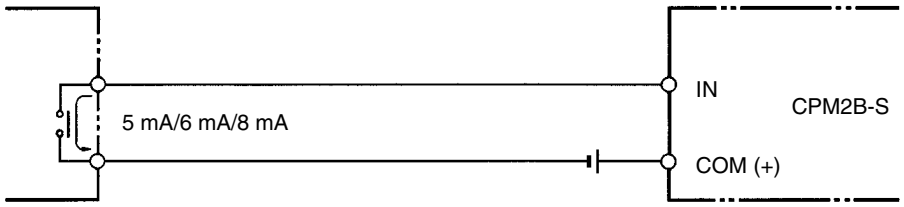
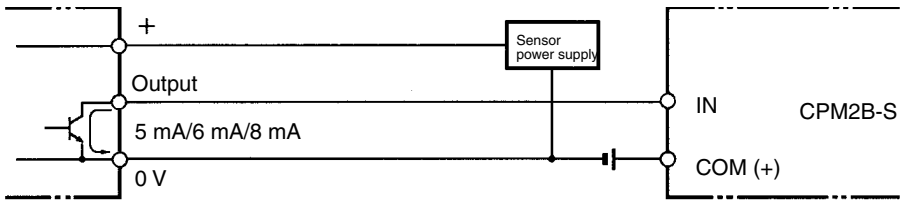
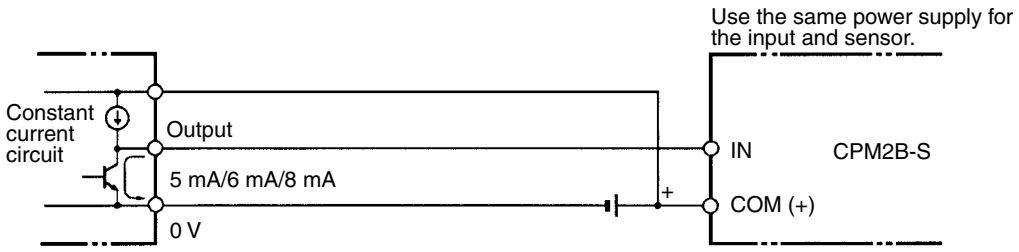
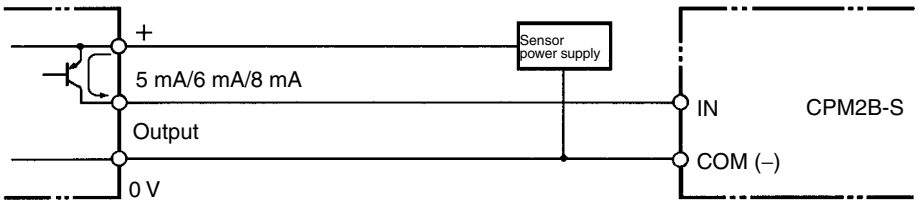
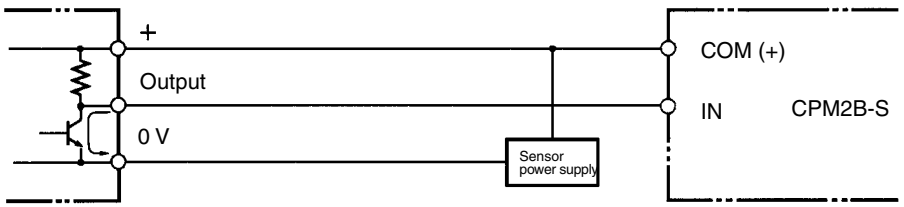


Diagram shows connector on the Board as viewed from the side from which the external connector is inserted.

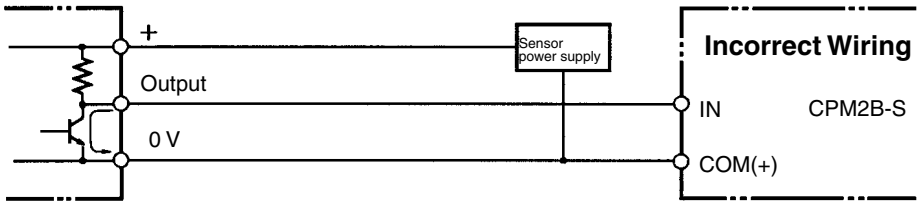
Note Refer to the *CPM2B Operation Manual* (W371) for I/O wiring information for Expansion I/O Boards.

3-5-2-4 Wiring Input Devices

The following table shows how to connect various input devices.

Device	Circuit diagram
Relay output	
NPN open collector	
NPN current output	
PNP current output	
Voltage output	

Note Do **not** use the following wiring with voltage-output devices:

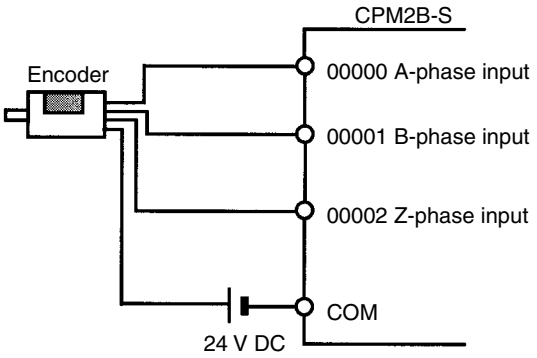


High-speed Counter Inputs (I/O Connector)

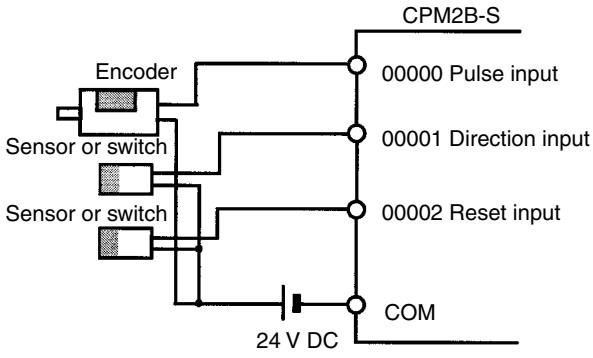
Using IR 00000 to IR 00002 as High-speed Counter Inputs

In these examples, Encoders with an external 24-V DC open-collector output are connected.

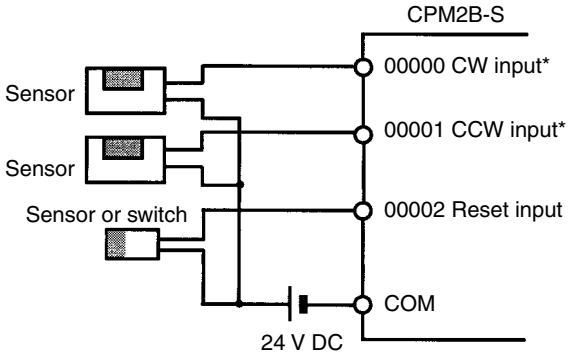
Differential Phase Mode (Count frequency: 5 kHz)



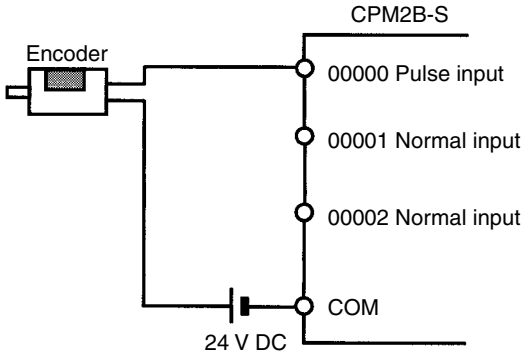
Pulse Plus Direction Input Mode (Count frequency: 20 kHz)



Up/Down Mode (Count frequency: 20 kHz)



Increment Mode (Count frequency: 20 kHz)

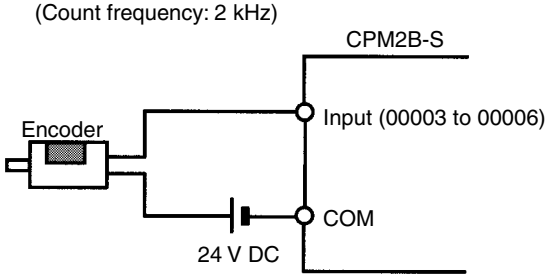


Note *CW is clockwise and CCW is counter-clockwise.

Using IR 00003 to IR 00005 as Interrupt Inputs (Counter Mode)

In these examples, an Encoder with an external 24-V DC open-collector output is connected.

Increment or decrement (Count frequency: 2 kHz)



PC Setup Settings

The input bits shown in the following tables can operate as normal inputs or they can be assigned special functions in the PC Setup.

Special functions for input bits IR 00000 through IR 00002 are set in DM 6642:

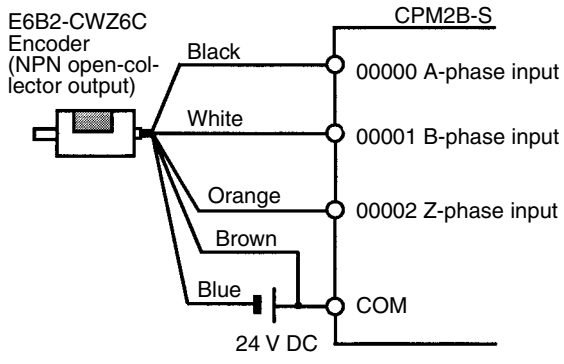
Bit address	PC Setup setting (DM 6642 bits 08 to15)		
	00	01	02, 03, or 04
IR 00000	Used as normal inputs.	Used as high-speed counter inputs.	Used as inputs for synchronized pulse control.
IR 00001			
IR 00002			Used as a normal input.

Special functions for input bits IR 00003 through IR 00005 are set in DM 6628:

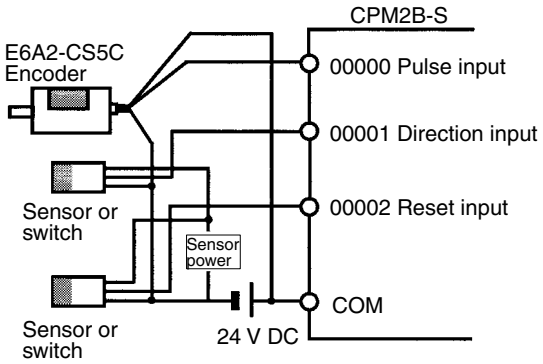
Bit address	Bits in DM 6628	PC Setup setting (in DM 6628)		
		0	1	2
IR 00003	00 to 03	Used as normal inputs.	Used as interrupt inputs (including counter mode).	Used as quick-response inputs.
IR 00004	04 to 07			

High-speed Counter Input Connection Examples

Differential Phase Mode (Count frequency: 5 kHz)

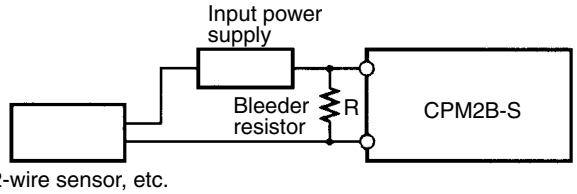


Pulse Plus Direction Input mode (Count frequency: 20 kHz)



Leakage Current

A leakage current can cause false inputs when using 2-wire sensors (proximity switches or photoelectric switches) or limit switches with LEDs. False inputs won't occur if the leakage current is less than 1.0 mA (2.5 mA for IN00000 to IN00002). If the leakage current exceeds these values, insert a bleeder resistor in the circuit to reduce the input impedance, as shown in the following diagram.



I: Device's leakage current (mA)
R: Bleeder resistance (kΩ)
W: Bleeder resistor's power rating (W)
L_C: CPM2B's input impedance (kΩ)
I_C: CPM2B's input current (mA)
E_C: CPM2B's OFF voltage (V) = 5.0 V

$$R = \frac{L_C \times 5.0}{I \times L_C - 5.0}\ \text{K}\Omega\ \text{max.} \qquad W = \frac{2.3}{R}\ \text{W min.}$$

The equations above were derived from the following equations:

$$I = \frac{R \times \dfrac{\text{Input voltage (24)}}{\text{Input Current } (I_C)}}{R + \dfrac{\text{Input voltage (24)}}{\text{Input Current } (I_C)}} \leq \text{OFF voltage } (E_C : 5.0)$$

$$W \geq \frac{\text{Input voltage (24)}}{R} \times \text{Input voltage (24)} \times \text{tolerance (4)}$$

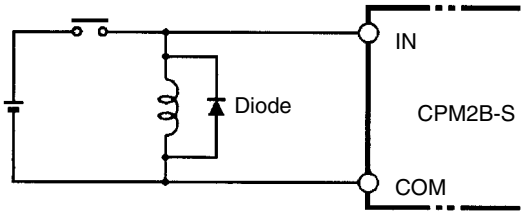
Refer to *2-1-3 I/O Specifications* for details on the values L_C, I_C, and E_C. The input impedance, input current, and OFF voltage may vary depending on the input being used. (IN00000 through IN00002 have different values.)

Inductive Loads

When connecting an inductive load to an input, connect a diode in parallel with the load. The diode should satisfy the following requirements:

1,2,3...

1. Peak reverse-breakdown voltage must be at least 3 times the load voltage.
2. Average rectified current must be 1 A.



3-5-2-5 Wiring Output Devices

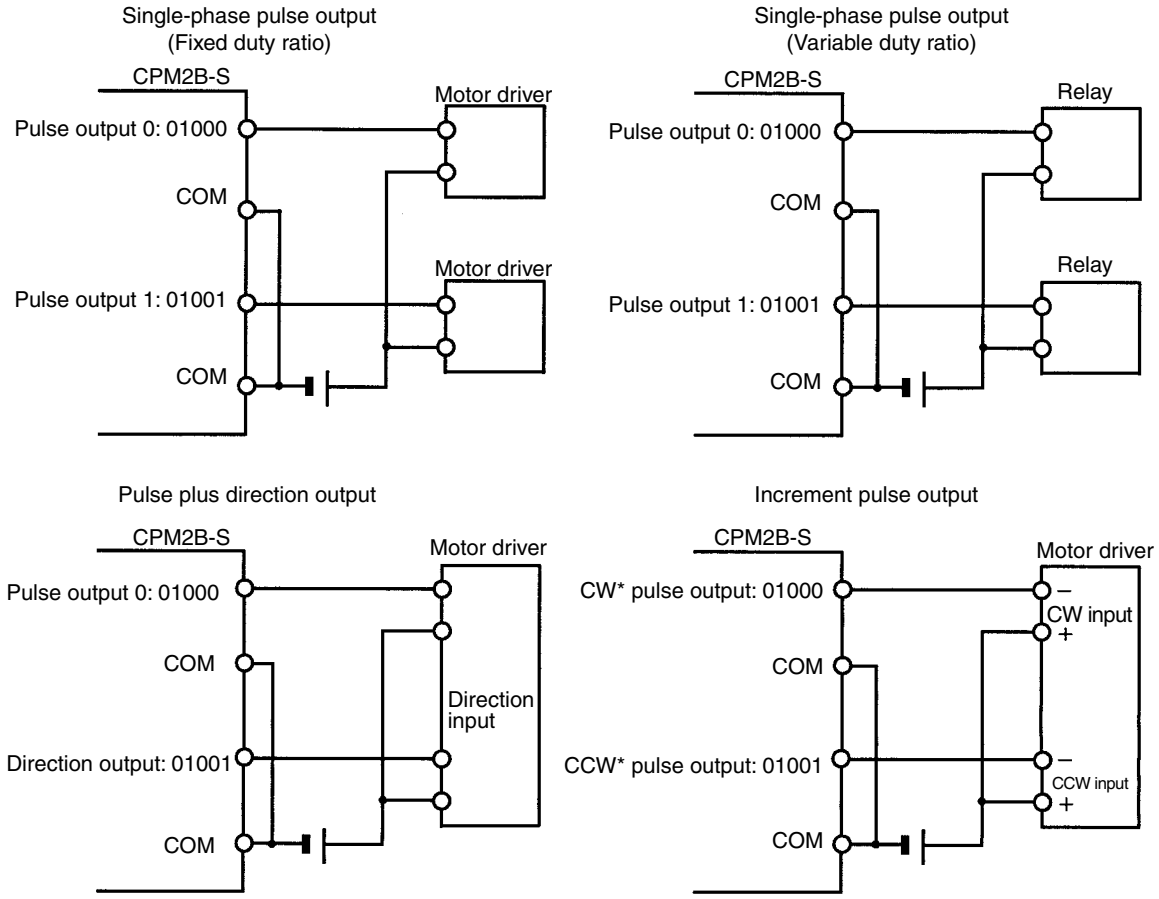
Wire the outputs to the CPM2B-S's CPU Board as shown in the following diagrams. Refer to the *CPM2B Operation Manual* (W371) for details on wiring outputs to Expansion I/O Boards.

Don't exceed the output capacity or the maximum common current. Refer to *2-1-3 I/O Specifications* for details.

⚠ **WARNING** The PC outputs may remain ON or OFF due to fusing or burning of the output relays or destruction of the output transistors. External safety measures must be provided to ensure safety in the system. Not providing proper safety measures may result in serious accidents.

Using Pulse Outputs (I/O Connector)

Use the PULS(65), SPED(– –), ACC(– –), PWM(– –), and SYNC(– –) instructions to produce pulse outputs (rather than normal outputs) from output bits IR 01000 and IR 01001. Pulse outputs are possible from CPU Boards with transistor outputs only.



Note *CW is clockwise and CCW is counter-clockwise.

Output Wiring Precautions

Observe the following precautions to protect the PC's internal components.

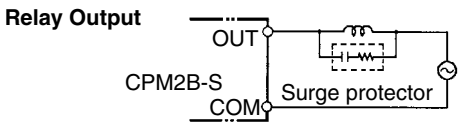
Output Short Protection

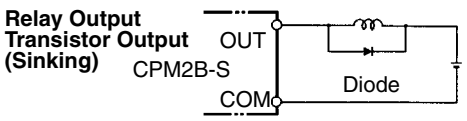
The output or internal circuitry might be damaged when the load connected to an output is short-circuited, so it is recommended to install a protective fuse in each output circuit.

Inductive Loads

When connecting an inductive load to an input, connect a surge protector or diode in parallel with the load.

The surge protector's components should have the following ratings:





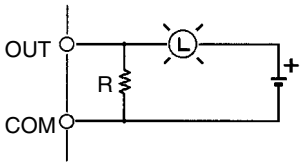
The diode should satisfy the following requirements:

Peak reverse-breakdown voltage must be at least 3 times the load voltage.
Average rectified current must be 1 A.

Inrush Current Considerations

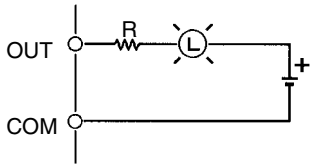
When a relay or transistor output is used to switch a load with a high inrush current such as an incandescent lamp, suppress the inrush current as shown below.

Countermeasure 1



Providing a dark current of approx. one-third of the rated value through an incandescent lamp

Countermeasure 2



Providing a limiting resistor

Fuse Insertion

The CPM2B-S with transistor output may burn if the load is short-circuited, therefore, insert a protective fuse in series with the load.

3-5-3 Wiring CompoBus/S Transmission Lines

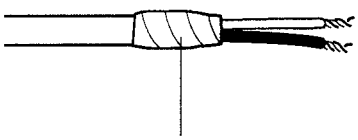
Use special flat cable or VCTF cable for the transmission lines that connect the nodes in the CompoBus/S I/O Link. (Special flat cables and VCTF cables cannot be combined in the same system.)

Name	Model number	Specifications
Flat cable	XB1T-W10	4-core flat cable, 0.75 mm^2
VCTF cable	---	2-core VCTF, 0.75 × 20

Use the following procedure to wire the CompoBus/S communications cables.

1,2,3... 1. Strip off the length of wire insulation recommended for the crimp connectors being used and tightly twist the bare wire strands together.

Note When VCTF cable is being used, cover the end of the cable sheathing with electrical tape or heat-shrink tubing as shown in the following diagram.



Secure the cable sheathing with electrical tape or heat-shrink tubing.

2. Crimp pin terminals on the stripped ends of the communications cable and secure the terminal and wire with electrical tape or heat-shrink tubing.

Note a) We recommend the following pin terminals.

Weidmüller 046290 Sleeve

Signal wire

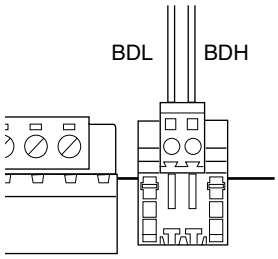
b) We recommend the following crimper:
Weidmüller PZ1.5 Crimper (part number 900599)

c) The Weidmüller 901851 Sleeve cannot be used.

3. Insert the pin terminals into the CompoBus/S terminal block on the CPM2B-S CPU Board and tighten the locking screw.

CompoBus/S Terminals

The CompoBus/S Terminal specifications are as follows:

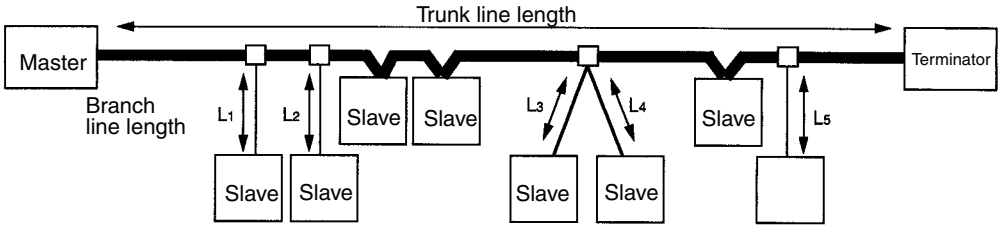


Tighten the terminal set screws to a torque of 0.2 to 0.4 N•m.

Note Before inserting the signal wires, loosen the terminal set screws sufficiently. If the set screws aren't loosened, it won't be possible to insert the wires fully and the wires won't be secured in the terminals.

Maximum Transmission Line Length

The maximum lengths of the trunk line, branch lines, and total transmission line length depend on the communications mode and the kind of transmission line (flat cable or VCTF cable) being used. The maximum lengths are further restricted if flat cable is being used with more than 16 Slaves.

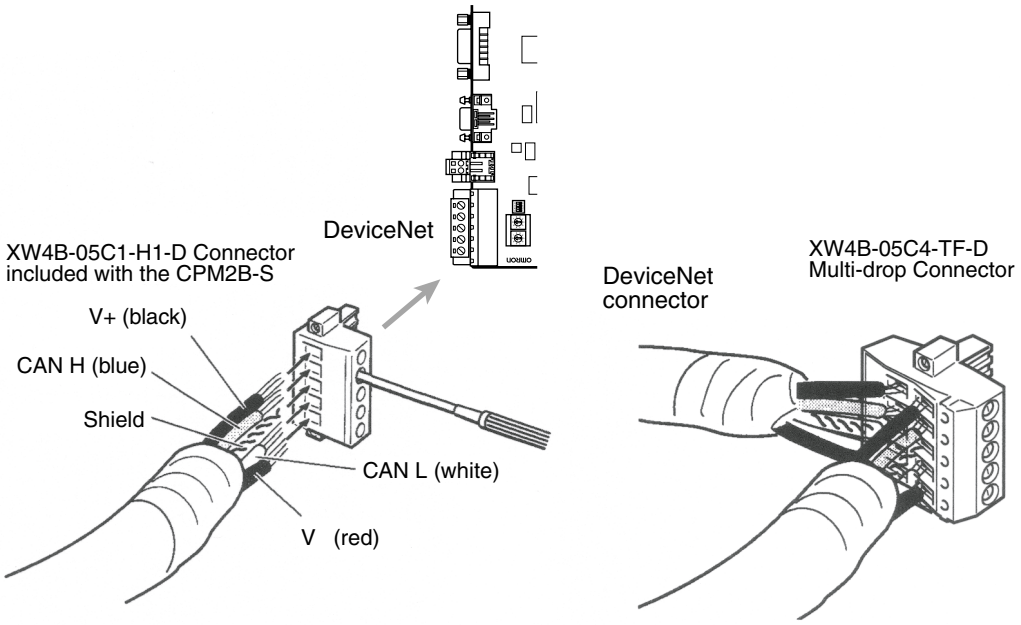


Total branch line length = $L_1 + L_2 + L_3 + L_4 + L_5$

Item	Max. length in high-speed mode			Max. length in long-distance mode	
	VCTF cable	Flat cable or 4-core VCTF cable		VCTF cable	Flat cable or 4-core VCTF cable
		Up to 16 Slaves	17 to 32 Slaves		
Trunk line length	100 m max.	100 m max.	30 m max.	500 m max.	Free branching
Branch line length	3 m max.	3 m max.	3 m max.	6 m max.	Total wire length: 200 m max.
Total branch line length	50 m max.	50 m max.	30 m max.	120 m max.	

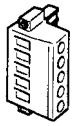
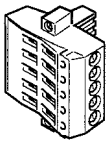
3-5-4 Wiring DeviceNet Communications Cables

Wire the DeviceNet communications cables as shown in the following diagram.



DeviceNet Connectors

Use the DeviceNet connectors shown in the following table.

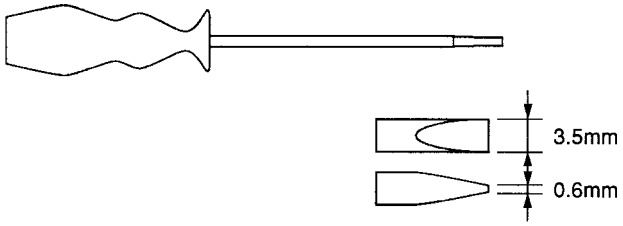
Connector	Appearance
OMRON XW4B-05C1-H1-D Connector with securing screws (included with the CPM2B-S)	
OMRON XW4B-05C4-TF-D Connector for multi-drop connections (see note 1)	

Note

1. Use the XW4B-05C4-T1-D Connector when wiring multi-drop connections with thick cable.
2. Phoenix Contact connectors can be purchased through OMRON Tsufo Service Company.

Use the following OMRON screwdriver when wiring DeviceNet connectors.

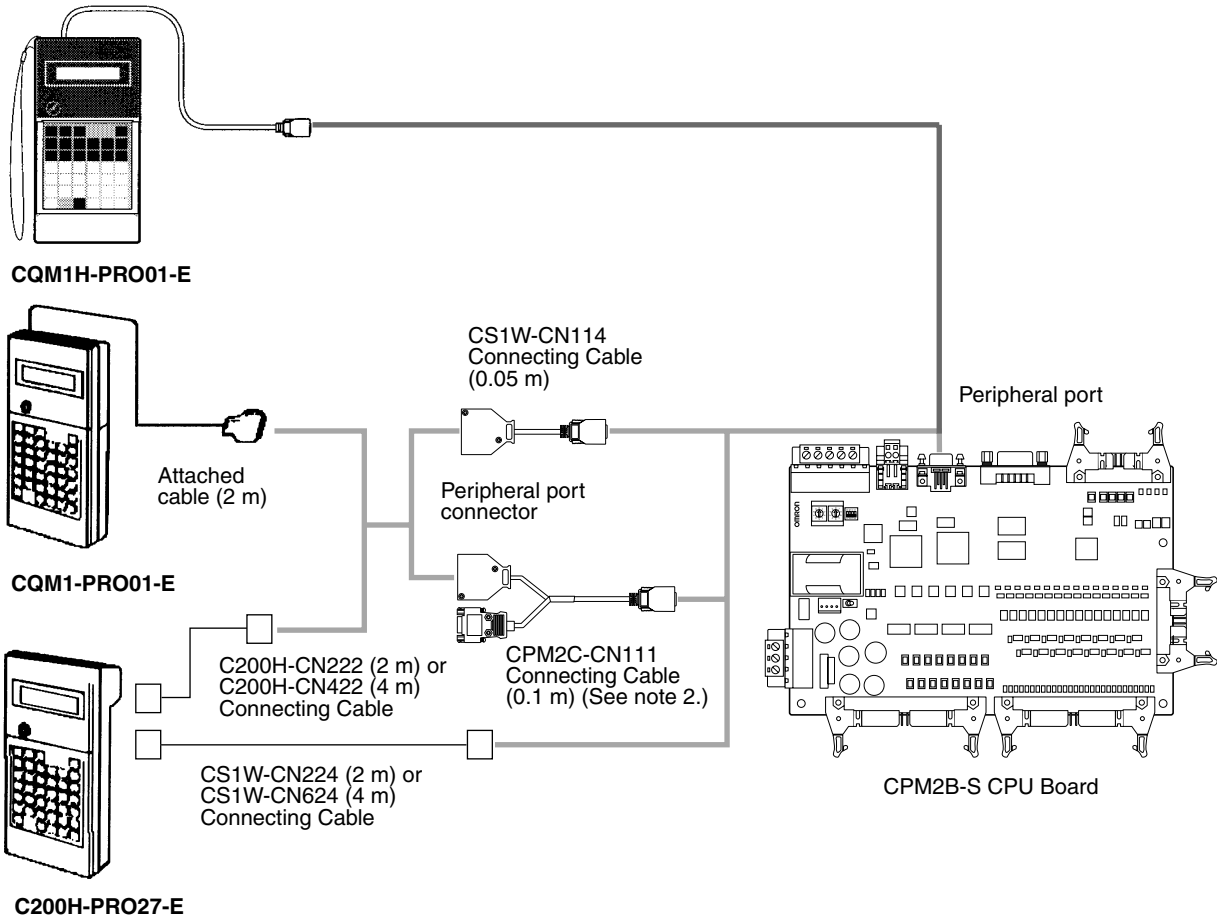
XW4Z-00C



3-5-5 Connecting a Programming Device to the Peripheral Port

3-5-5-1 Connecting a Programming Console

Connect the Programming Console's connecting cable to the CPM2B-S's peripheral port, as shown below.

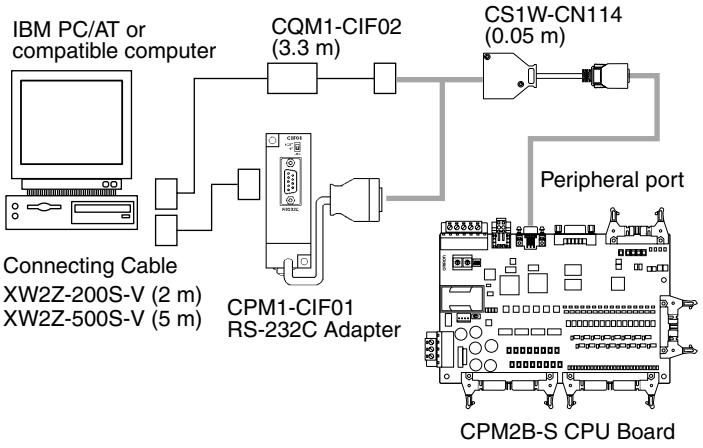


Peripheral Port Connector Use the peripheral port to connect to a device such as a Programming Console or personal computer.

Note A personal computer or PT cannot be connected when a CPM2C-CN111 or CS1W-CN118 is used because their RS-232C connectors do not pass through to the peripheral port. If you want to connect a computer or PT, use a CS1W-CN114 in combination with a CPM1-CIF01 or CPM1-CIF11.

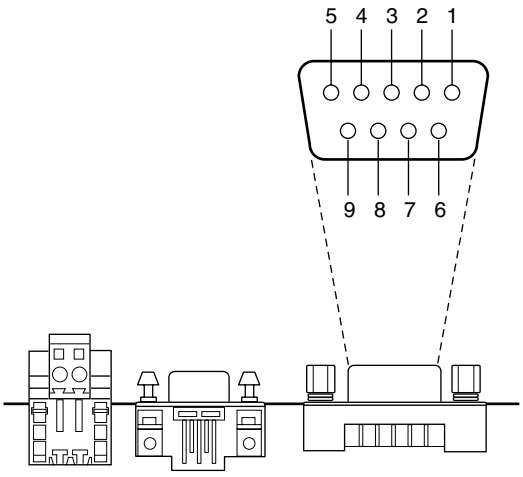
3-5-5-2 Computer Connections

Peripheral Port Connection



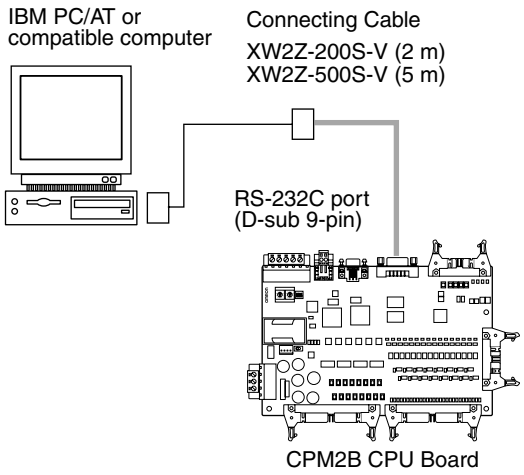
3-5-6 Connecting to the RS-232C Port

RS-232C Port Connector The following table shows the pin allocation of the RS-232C port connector.



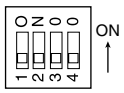
Pin No.	Signal abbreviation	Signal name	Direction
1	FG	Frame ground	---
2	SD (TXD)	Send data	Output
3	RD (RXD)	Receive data	Input
4	RS (RTS)	Request to send	Output
5	CS (CTS)	Clear to send	Input
6	5 V	Power supply	---
7	---	Not used.	---
8	---	Not used.	---
9	SG	Signal ground	---
Connector opening	FG	Frame ground	---

RS-232C Port Connection



Note

1. When an NT-AL001 Adapter is connected to the RS-232C port, the NT-AL001 is supplied with +5 V DC power. The power supplied to the NT-AL001 reduces the power available for Expansion I/O Boards, so only 1 Expansion I/O Board may be connected when an NT-AL001 Adapter is connected.
2. The communications settings of the RS-232C port are determined by the setting of pin 3 on the DIP switch.



Pin 3	RS-232C port communications settings
OFF	The settings in PC Setup words DM 6645 to DM 6654 are used.
ON	The following standard settings are used. Start bits: 1bit Data length: 7 bits Stop bits: 2 bits Parity: Even Baud rate: 9,600 bps Host Link unit No.: 0

SECTION 4
Memory Areas

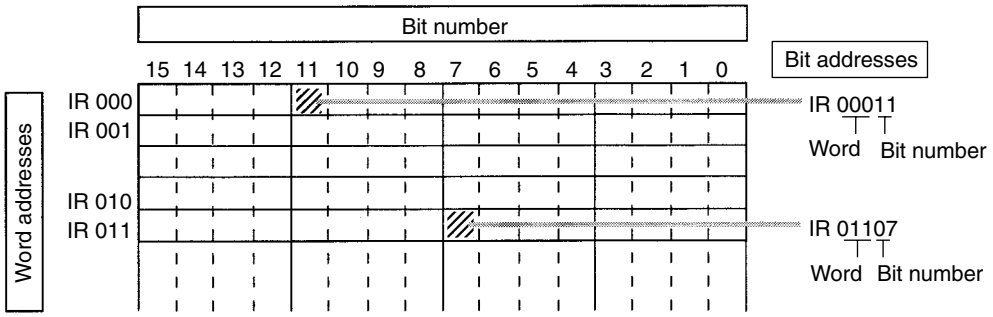
This section describes the structure of the PC memory areas and explains how to use them.

4-1 Introduction 58
4-1-1 Functions 59
4-1-2 I/O Memory Area Attributes 62
4-2 I/O Allocation for CPM2B-S PCs 63
4-3 I/O Allocation to CompoBus/S Slaves 65
4-4 SR Area 66
4-5 AR Area 69
4-6 PC Setup 73
4-6-1 Overview 73
4-6-2 PC Setup Settings 74
4-7 Basic PC Operation and I/O Processes 79
4-7-1 Startup Mode 79
4-7-2 Hold Bit Status 80
4-7-3 Program Memory Write-protection 80
4-7-4 RS-232C Port Servicing Time 81
4-7-5 Peripheral Port Servicing Time 81
4-7-6 Cycle Monitor Time 81
4-7-7 Minimum Cycle Time 82
4-7-8 Input Time Constants 82
4-7-9 Error Detection and Error Log Settings 83
4-8 Error Log 84

4-1 Introduction

Most data areas in the CPM2B-S can be accessed as bits or words. (The TR area can be accessed by bit address only and the DM area can be accessed by word address only.)

The following diagram shows the structure of the IR area and the relationship between bit and word addresses.



The following memory areas can be used in the CPM2B-S.

Data area		Words	Bits	Function
IR area	Input area	IR 000 to IR 009 (10 words)	IR 00000 to IR 00915 (160 bits)	These bits are allocated to the external I/O terminals.
	Output area	IR 010 to IR 019 (10 words)	IR 01000 to IR 01915 (160 bits)	(Words not used as I/O words can be used as work words.)
	CompoBus/S input area	IR 020 to IR 027 (8 words)	IR 02000 to IR 02715 (128 bits)	These bits are allocated to CompoBus/S Slaves.
	CompoBus/S output area	IR 030 to IR 037 (8 words)	IR 03000 to IR 03715 (128 bits)	(Words not used as I/O words can be used as work words.)
	Work area	IR 028 and IR 029, IR 038 to IR 049, IR 200 to IR 227 (42 words)	IR 02800 to IR 02915, IR 03800 to IR 04915, IR 20000 to IR 22715 (672 bits)	Work bits can be freely used within the program.
SR area		SR 228 to SR 255 (28 words)	SR 22800 to SR 25515 (448 bits)	These bits serve specific functions such as flags and control bits.
TR area		---	TR 0 to TR 7 (8 bits)	These bits are used to temporarily store ON/OFF status at program branches.
HR area[1]		HR 00 to HR 19 (20 words)	HR 0000 to HR 1915 (320 bits)	These bits store data and retain their ON/OFF status when power is turned OFF, or operation starts or stops. They are used in the same way as work bits.
AR area[1]		AR 00 to AR 23 (24 words)	AR 0000 to AR 2315 (384 bits)	These bits serve specific functions such as flags and control bits.
LR area		LR 00 to LR 15 (16 words)	LR 0000 to LR 1515 (256 bits)	Used for a 1:1 PC Link with another PC.
Timer/Counter area[1]		TC 000 to TC 255 (timer/counter numbers)[2]		Timers and counters use the TIM, TIMH(15), CNT, CNTR(12), TMHH(– –), and TIML(– –) instructions. The same numbers are used for both timers and counters.

Data area		Words	Bits	Function
DM area	Read/write[1]	DM 0000 to DM 1999 DM 2022 to DM 2047 (2,026 words)	---	DM area data can be accessed in word units only. Word values are retained when the power is turned off, or operation started or stopped. Read/write areas can be read and written freely within the program.
	Error log	DM 2000 to DM 2021 (22 words)	---	Used to store the time of occurrence and error code of errors that occur. These words can be used as ordinary read/write DM when the error log function isn't being used.
	Read-only[3,4]	DM 6144 to DM 6599 (456 words)	---	Cannot be overwritten from program.
	PC Setup[3,4]	DM 6600 to DM 6655 (56 words)	---	Used to store various parameters that control PC operation.

Note

1. The contents of the HR area, AR area, Counter area, and read/write DM area are backed up the capacitor or battery (optional) in the CPU Unit. The backup time without a battery (optional) is approximately 10 days at 25°C. Backup time with a battery (optional) connected is approximately 5 years at 25°C.
2. When a TC numbers is used as a word operand, the timer or counter PV is accessed; when used as a bit operand, its Completion Flag is accessed.
3. Data in DM 6144 to DM 6655 cannot be overwritten from the program, but they can be changed from a Programming Device.
4. The program and data in DM 6144 to DM 6655 are stored in flash memory.

4-1-1 Functions

IR Area

The functions of the IR area are explained below.

IR area bits from IR 00000 to IR 00515 and IR 01000 to IR 01515 are allocated to terminals on the CPU Board and Expansion I/O Boards. IR words that are not allocated to inputs or outputs can be used as work words. Input words begin with IR 000 and output words begin with IR 010.

Note

1. The input bits shown in the following tables can operate as normal inputs or they can be assigned special functions in the PC Setup.

   Special functions for input bits IR 00000 through IR 00002 are set in DM 6642:

Bit address	PC Setup setting (DM 6642 bits 08 to15)		
	00	01	02, 03, or 04
IR 00000	Used as normal inputs.	Used as high-speed counter inputs.	Used as inputs for synchronized pulse control.
IR 00001			
IR 00002			Used as a normal input.

   Special functions for input bits IR 00003 and IR 00004 are set in DM 6628:

Bit address	Bits in DM 6628	PC Setup setting (in DM 6628)		
		0	1	2
IR 00003	00 to 03	Used as normal inputs.	Used as interrupt inputs (including counter mode).	Used as quick-response inputs.
IR 00004	04 to 07			

2. Output bits IR 01000 and IR 01001 can operate as normal inputs or they can be used for pulse outputs with PULS(65), SYNC(– –), or PWM(– –). (Use a CPU Board with transistor outputs for the pulse output functions.)

Instruction	Function
PULS(65)	With SPED(64): Single-phase pulse output without acceleration or deceleration
	With ACC(– –): Single-phase pulse output with trapezoidal acceleration and deceleration
SYNC(– –)	Synchronized pulse control output
PWM(– –)	Variable duty-ratio pulse output

CompoBus/S I/O Areas

IR area bits from IR 02000 to IR 02715 (the input area) and IR 03000 to IR 03715 (the output area) are allocated to CompoBus/S Slaves. IR words that are not allocated to CompoBus/S inputs or outputs can be used as work words.

Work Bits

The work bits can be used freely within the program. They can only be used within the program, however, and not for direct external I/O.

SR Area

These bits mainly serve as flags to PC operation or contain present and set values for various functions. Words SR 253 to SR 255 are read-only. For details on the various bit functions, refer to *4-4 SR Area*.

TR Area

When a complex ladder diagram cannot be programmed in mnemonic code just as it is, these bits are used to temporarily store ON/OFF execution conditions at program branches. They are used only for mnemonic code. When programming directly with ladder diagrams using the SYSMAC Support Software (SSS) or the SYSMAC-CPT Support Software, TR bits are automatically processed for you.

The same TR bits cannot be used more than once within the same instruction block, but can be used again in different instruction blocks. The ON/OFF status of TR bits cannot be monitored from a Programming Device.

Examples showing the use of TR bits in programming are provided in the *CPM1/CPM1A/CPM2A/CPM2C/SRM1(-V2) Programming Manual* (W353).

HR Area

These bits retain their ON/OFF status even after the PC power supply has been turned off or when operation begins or stops. They are used in the same way as work bits.

AR Area

These bits mainly serve as flags related to PC operation. These bits retain their status even after the PC power supply has been turned off or when operation begins or stops. For details on the various bit functions, refer to *4-5 AR Area*.

LR Area

These bits are used to exchange data when the CPM2B-S is linked 1:1 with another CPM2B-S or a CPM1, CPM1A, CPM2A, CPM2C, CPM2C-S, CPM2B, SRM1(-V2), CQM1, CQM1H, C200HS, or C200HX/HG/HE PC.

Timer/Counter Area

This area is used to manage timers and counters created with TIM, TIMH(15), TMHH(– –)*, TIML(– –)*, CNT, and CNTR(12). The same numbers are used for both timers and counters and each number can be used only once in the user program. Do not use the same TC number twice even for different instructions.

Use TC numbers 000 through 003 for TIMH(15) and TC numbers 004 to 007 for TMHH(– –)*. When these timer numbers are used, timing is performed as an interrupt process and the cycle timer does not affect timer operation.

TC numbers are used to create timers and counters, as well as to access Completion Flags and present values (PVs). If a TC number is designated for

word data, it will access the present value (PV); if it is used for bit data, it will access the Completion Flag for the timer/counter.

DM Area

DM area data is accessed in word units only. The contents of the DM area are retained even after the PC power supply has been turned off or when operation begins or stops.

DM words DM 0000 through DM 1999 and DM 2022 through DM 2047 can be used freely in the program; other DM words are allocated specific functions, described below.

DM 2000 through DM 2021 contain the error log information. Refer to *Section 9 Troubleshooting* for details on the error log.

Note DM 6600 through DM 6655 contain the PC Setup. Refer to *4-6 PC Setup* for details.

4-1-2 I/O Memory Area Attributes

Area	External I/O allocation	Mode change (to or from PROGRAM)		Fatal error				Startup (Power ON)				Force Set, Force Reset
				FALS(07)		Other cause		Reset IOM Hold Bit[1]		Maintain IOM Hold Bit[1]		
		IOM Hold Bit OFF	IOM Hold Bit ON	IOM Hold Bit OFF	IOM Hold Bit ON	IOM Hold Bit OFF	IOM Hold Bit ON	IOM Hold Bit OFF	IOM Hold Bit ON	IOM Hold Bit OFF	IOM Hold Bit ON	
Input area (IR 000 to IR 009)	Yes	Clear	Hold	Hold	Hold	Clear	Hold	Clear	Clear	Clear	Hold	OK
Output area (IR 010 to IR 019)	Yes	Clear	Hold	Hold	Hold	Clear	Hold	Clear	Clear	Clear	Hold	OK
CompoBus/S input area (IR 020 to IR 027)	No	Clear	Hold	Hold	Hold	Clear	Hold	Clear	Clear	Clear	Hold	OK
CompoBus/S output area (IR 030 to IR 037)	No	Clear	Hold	Hold	Hold	Clear	Hold	Clear	Clear	Clear	Hold	OK
Work areas (IR 028, IR 029, IR 030 to IR 049, IR 220 to IR 227)	No	Clear	Hold	Hold	Hold	Clear	Hold	Clear	Clear	Clear	Hold	OK
SR area (SR 228 to SR 255)	No											
HR area (HR 00 to HR 19)	No	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	OK
AR area (AR 00 to AR 23)	No											OK
LR area (LR 00 to LR 15)	No	Clear	Hold	Hold	Hold	Clear	Hold	Clear	Clear	Clear	Hold	OK
Timer Completion Flags (T000 to T255)	No	Hold[2]	Hold[2]	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	OK
Timer PVs (T000 to T255)	No	Hold[2]	Hold[2]	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	No
Counter Completion Flags (C000 to C255)	No	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	OK
Counter PVs (C000 to C255)	No	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	No
DM area	No	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	Hold	No
Read/Write (DM 0000 to DM 1999, DM 2022 to DM 2047)												
Error Log (DM 2000 to DM 2021)												
Read-only (DM 6144 to DM 6599)												
PC Setup (DM 6600 to DM 6655)												

Note

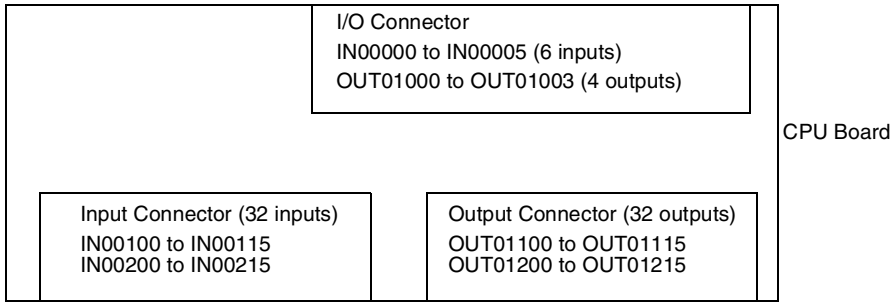
1. The PC Setup setting in DM 6601 bits 08 to 11 determines whether the IOM Hold Bit is reset (turned OFF) at startup.
2. Timer PVs and Completion Flags are maintained when the CPM2B-S is switched to PROGRAM mode from RUN mode or MONITOR mode, but cleared when the CPM2B-S is switched from PROGRAM mode to RUN mode or MONITOR mode.

4-2 I/O Allocation for CPM2B-S PCs

This section shows how I/O bits are actually allocated to the input and output terminals on the CPU Board and Expansion I/O Boards. Bits in the words that are not allocated to I/O can be used as work bits.

CPU Board I/O Allocation

The CPU Board has three connectors: an I/O connector with 6 inputs and 4 outputs, an input connector with 32 inputs, and an output connector with 32 outputs. Inputs are allocated to words IR 000 through IR 002 and outputs are allocated to words IR 010 through IR 012, as shown in the following diagram.



Bits		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00	
Inputs	IR 000	Do not use.																I/O connector
	IR 001																	Input connector
	IR 002																	
Outputs	IR 010																	I/O connector
	IR 011																	Output connector
	IR 012																	

Note

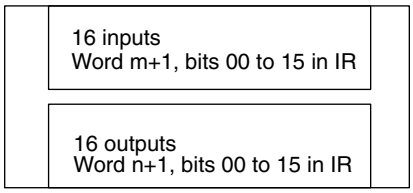
1. Unused input bits IR 00006 to IR 00015 **cannot** be used as work bits.
2. Unused output bits IR 00104 to IR 00115 **can** be used as work bits.

Expansion I/O Board I/O Allocation

Up to 3 Expansion I/O Boards can be connected.

Input bits are allocated to Expansion I/O Boards starting from word (m+1), where “m” is the last input word allocated to the CPU Board or to the previous Expansion I/O Board if one is already connected.

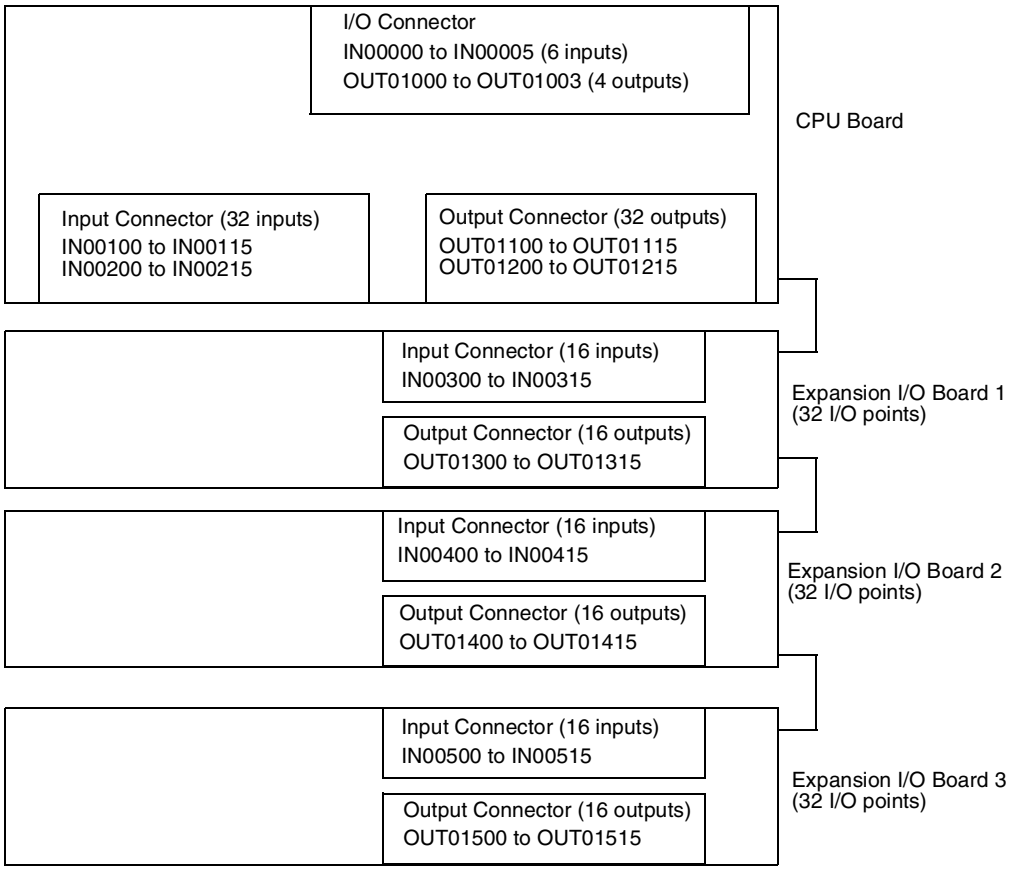
Output bits are allocated to Expansion I/O Boards starting from word (n+1), where “n” is the last output word allocated to the CPU Board or to the previous Expansion I/O Board if one is already connected.



Bits		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
Inputs	m+1																
Outputs	n+1																

CPU Board and Three Expansion I/O Boards

The following example shows the I/O allocation when three Expansion I/O Boards are connected to the CPU Board.



The numbers of the Expansion I/O Boards, 1 to 3, indicate the order in which they are connected to the CPU Board.

Bits		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00		
Inputs	IR 000	Do not use.																I/O connector	CPU Board
	IR 001																	Input connector	
	IR 002																		
	IR 003																	Input connector	Expansion I/O Board 1
	IR 004																	Input connector	Expansion I/O Board 2
	IR 005																	Input connector	Expansion I/O Board 3
Outputs	IR 010																	I/O connector	CPU Board
	IR 011																	Output connector	
	IR 012																		
	IR 013																	Output connector	Expansion I/O Board 1
	IR 014																	Output connector	Expansion I/O Board 2
	IR 015																	Output connector	Expansion I/O Board 3

Note
1. Unused input bits IR 00006 to IR 00015 **cannot** be used as work bits.
2. Unused output bits IR 01004 to IR 01015 **can** be used as work bits.

4-3 I/O Allocation to CompoBus/S Slaves

The CompoBus/S input area (IR 020 to IR 027) and CompoBus/S output area (IR 030 to IR 037) are allocated for the CompoBus/S Terminal's I/O. The following table shows the I/O allocation of the CompoBus/S Terminal (IN0 to IN15 and OUT0 to OUT15.)

I/O	Bit address															
	IR word	Bit number														
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Input area	020	IN1								IN0							
	021	IN3								IN2							
	022	IN5								IN4							
	023	IN7								IN6							
	024	IN9								IN8							
	025	IN11								IN10							
	026	IN13								IN12							
	027	IN15								IN14							
Output area	030	OUT1								OUT0							
	031	OUT3								OUT2							
	032	OUT5								OUT4							
	033	OUT7								OUT6							
	034	OUT9								OUT8							
	035	OUT11								OUT10							
	036	OUT13								OUT12							
	037	OUT15								OUT14							

Note

1. IN0 to IN15 are node numbers of Input Terminals and OUT0 to OUT15 are node numbers of Output Terminals.
2. When the maximum number of CompoBus/S nodes is set to 16, IN8 to IN15 and OUT8 to OUT15 can be used as work bits.
3. CompoBus/S Terminals with 8 points or less are allocated I/O bits in byte units beginning from bit 00 or bit 08.
4. Only even addresses can be specified for 16-point CompoBus/S Terminals.

4-4 SR Area

These bits mainly serve as flags related to CPM2B-S operation or contain present and set values for various functions. The functions of the SR area are explained in the following table.

Note "Read-only" words and bits can be read as status in controller PC operation, but they cannot be written from the ladder program. Bits and words that are "Not used" are also read-only.

Word(s)	Bit(s)	Function	Read/ write
SR 228, SR 229	00 to 15	**Pulse Output PV 0** Contains the pulse output PV (–16,777,215 to 16,777,215). SR 22915 acts as the sign bit; a negative number is indicated when SR 22915 is ON. (The same PV data can be read immediately with PRV(62).) Only Pulse Output PV 0 is used for ACC(– –).	Read-only
SR 230, SR 231	00 to 15	**Pulse Output PV 1** Contains the pulse output PV (–16,777,215 to 16,777,215). SR 23115 acts as the sign bit; a negative number is indicated when SR 23115 is ON. (The same PV data can be read immediately with PRV(62).)	
SR 232 to SR 235	00 to 15	**Macro Function Input Area** Contains the input operands for MCRO(99). (Can be used as work bits when MCRO(99) is not used.)	Read/ write
SR 236 to SR 239	00 to 15	**Macro Function Output Area** Contains the output operands for MCRO(99). (Can be used as work bits when MCRO(99) is not used.)	
SR 240	00 to 15	**Interrupt Input 00003 Counter Mode SV** SV when interrupt input 00003 is used in counter mode (4 digits hexadecimal). (Can be used as work bits when interrupt input 00003 is not used in counter mode.)	
SR 241	00 to 15	**Interrupt Input 00004 Counter Mode SV** SV when interrupt input 00004 is used in counter mode (4 digits hexadecimal). (Can be used as work bits when interrupt input 00004 is not used in counter mode.)	
SR 242, SR 243	00 to 15	Not used.	
SR 244	00 to 15	**Interrupt Input 00003 Counter Mode PV** Counter PV when interrupt input 00003 is used in counter mode (4 digits hexadecimal).	Read-only
SR 245	00 to 15	**Interrupt Input 00004 Counter Mode PV** Counter PV when interrupt input 00004 is used in counter mode (4 digits hexadecimal).	
SR 246, SR 247	00 to 15	Not used.	
SR 248, SR 249	00 to 15	**High-speed Counter PV Area** (Can be used as work bits when the high-speed counter is not used.)	Read-only
SR 250, SR 251	00 to 15	Not used.	

Word(s)	Bit(s)	Function	Read/ write
SR 252	00	**High-speed Counter Reset Bit**	Read/ write
	01 to 03	Not used.	
	04	**Pulse Output 0 PV Reset Bit** Turn ON to clear the PV of pulse output 0.	Read/ write
	05	**Pulse Output 1 PV Reset Bit** Turn ON to clear the PV of pulse output 1.	
	06, 07	Not used.	
	08	**Peripheral Port Reset Bit** Turn ON to reset the peripheral port. Automatically turns OFF when reset is complete.	Read/ write
	09	**RS-232C Port Reset Bit** Turn ON to reset the RS-232C port. Automatically turns OFF when reset is complete.	
	10	**PC Setup Reset Bit** Turn ON to initialize PC Setup (DM 6600 through DM 6655). Automatically turns OFF again when reset is complete. Only effective if the PC is in PROGRAM mode.	
	11	**Forced Status Hold Bit** (See note.) OFF: The forced status of bits that are forced set/reset is cleared when switching between PROGRAM mode and MONITOR mode. ON: The status of bits that are forced set/reset are maintained when switching between PROGRAM mode and MONITOR mode. The PC Setup can be set to maintain the status of this bit when the PC is turned off.	
	12	**I/O Hold Bit** (See note.) OFF: IR and LR bits are reset when starting or stopping operation. ON: IR and LR bit status is maintained when starting or stopping operation. The PC Setup can be set to maintain the status of this bit when the PC is turned off.	
	13	Not used.	
	14	**Error Log Reset Bit** Turn ON to clear error log. Automatically turns OFF again when operation is complete.	Read/ write
	15	Not used.	

Word(s)	Bit(s)	Function	Read/ write
SR 253	00 to 07	**FAL Error Code** The error code (a 2-digit number) is stored here when an error occurs. The FAL number is stored here when FAL(06) or FALS(07) is executed. This word is reset (to 00) by executing a FAL 00 instruction or by clearing the error from a Programming Device.	Read-only
	08	**Battery Error Flag** Turns ON when the CPU Unit backup battery's voltage is too low. A low battery will be detected only when the low battery detection switch is turned ON (see page 31) and bits 12 to 15 of DM 6655 are set to 0.	
	09	**Cycle Time Overrun Flag** Turns ON when a cycle time overrun occurs (i.e., when the cycle time exceeds 100 ms).	
	10,11	Not used.	
	12	**Changing RS-232C Setup Flag** Turns ON when the RS-232C port's settings are being changed.	Read/ write
	13	**Always ON Flag**	Read-only
	14	**Always OFF Flag**	
	15	**First Cycle Flag** Turns ON for 1 cycle at the start of operation.	
SR 254	00	1-minute clock pulse (30 seconds ON; 30 seconds OFF)	
	01	0.02-second clock pulse (0.01 second ON; 0.01 second OFF)	
	02	**Negative (N) Flag**	
	03	Not used.	
	04	**Overflow (OF) Flag** Turns ON when an overflow occurs in a signed binary calculation.	Read-only
	05	**Underflow (UF) Flag** Turns ON when an underflow occurs in a signed binary calculation.	
	06	**Differential Monitor Complete Flag** Turns ON when differential monitoring is completed.	
	07	**STEP(08) Execution Flag** Turns ON for 1 cycle only at the start of process based on STEP(08).	
	08 to 15	Not used.	
SR 255	00	0.1-second clock pulse (0.05 second ON; 0.05 second OFF)	Read-only
	01	0.2-second clock pulse (0.1 second ON; 0.1 second OFF)	
	02	1.0-second clock pulse (0.5 second ON; 0.5 second OFF)	
	03	**Instruction Execution Error (ER) Flag** Turns ON when an error occurs during execution of an instruction.	
	04	**Carry (CY) Flag** Turns ON when there is a carry in the results of an instruction execution.	
	05	**Greater Than (GR) Flag** Turns ON when the result of a comparison operation is "greater."	
	06	**Equals (EQ) Flag** Turns ON when the result of a comparison operation is "equal," or when the result of an instruction execution is 0.	
	07	**Less Than (LE) Flag** Turns ON when the result of a comparison operation is "less."	
	08 to 15	Not used.	

Note DM 6601 in the PC Setup can be set to maintain the previous status of the Forced Status Hold Bit (SR 25211) and the I/O Hold Bit (SR 25212) when power is turned OFF.

4-5 AR Area

These bits mainly serve as flags related to CPM2B-S operation such as error flags, high-speed counter flags, pulse output operation flags, and cycle time values. These bits retain their status even after the CPM2B-S power supply has been turned off or when operation begins or stops.

Word(s)	Bit(s)	Function	
AR 00 (-DRT only)	00	DeviceNet switch settings error (ON when a settings error occurred, OFF when normal.)	
	01	Node number duplication or Bus off error (ON when an error occurred, OFF when normal.)	
	02	DeviceNet network power supply error (ON when an error occurred, OFF when normal.)	
	03	DeviceNet communications error (ON when an error occurred, OFF when normal.)	
	04 to 06	Not used.	
	07	DeviceNet status error (ON when an error occurred, OFF when normal.)	
	08	Explicit Connection Flag	ON: Connection established. OFF: Connection not established.
	09	Polling Connection Flag	
	10	Bit Strobe Connection Flag	
	11 to 14	Not used.	
	15	I/O Link in progress (ON when the I/O Link is operating, otherwise OFF.)	
AR 01	00 to 15	Reserved for the system (These bits cannot be used.)	
AR 02	00	Expansion Board Error Flag for 1st Unit	These flags turn ON when there is an error in the corresponding Unit.
	01	Expansion Board Error Flag for 2nd Unit	
	02	Expansion Board Error Flag for 3rd Unit	
	03 to 07	Not used.	
	08 to 11	Number of Expansion I/O Boards connected	
	12 to 15	Not used.	
AR 03	00 to 15	Not used.	
AR 04	00 to 07	CompoBus/S Active Slave Flags for OUT 0 to OUT7 (ON when the Slave is communicating.)	
	08 to 15	CompoBus/S Slave Communications Error Flags for OUT 0 to OUT7	
AR 05	00 to 07	CompoBus/S Active Slave Flags for IN0 to IN7 (ON when the Slave is communicating.)	
	08 to 15	CompoBus/S Slave Communications Error Flags for IN0 to IN7	
AR 06	00 to 07	CompoBus/S Active Slave Flags for OUT 8 to OUT15 (ON when the Slave is communicating.)	
	08 to 15	CompoBus/S Slave Communications Error Flags for OUT 8 to OUT15	
AR 07	00 to 07	CompoBus/S Active Slave Flags for IN8 to IN15 (ON when the Slave is communicating.)	
	08 to 15	CompoBus/S Slave Communications Error Flags for IN8 to IN15	

Word(s)	Bit(s)	Function
AR 08	00 to 03	**RS-232C Port Error Code** 0: Normal completion 1: Parity error 2: Frame error 3: Overrun error
	04	**RS-232C Communications Error Flag** Turns ON when an RS-232C port communications error occurs.
	05	**RS-232C Transmit Ready Flag** Turns ON when the PC is ready to transmit data. (No-protocol and Host Link only)
	06	**RS-232C Reception Completed Flag** Turns ON when the PC has completed reading data. (No-protocol only)
	07	**RS-232C Reception Overflow Flag** Turns ON when an overflow has occurred. (No-protocol only)
	08 to 11	**Peripheral Port Error Code** 0: Normal completion 1: Parity error 2: Frame error 3: Overrun error
	12	**Peripheral Port Communications Error Flag** Turns ON when a peripheral port communications error occurs.
	13	**Peripheral Port Transmit Ready Flag** Turns ON when the PC is ready to transmit data. (No-protocol and Host Link only)
	14	**Peripheral Port Reception Completed Flag** Turns ON when the PC has completed reading data. (No-protocol only)
	15	**Peripheral Port Reception Overflow Flag** Turns ON when an overflow has occurred. (No-protocol only)
AR 09	00 to 15	**RS-232C Port Reception Counter** (4 digits BCD) Valid only when no-protocol communications are used.
AR 10	00 to 15	**Peripheral Port Reception Counter** (4 digits BCD) Valid only when no-protocol communications are used.

Word(s)	Bit(s)	Function
AR 11 (Note 1)	00 to 07	**High-speed Counter Range Comparison Flags** 00 ON: Counter PV is within comparison range 1 01 ON: Counter PV is within comparison range 2 02 ON: Counter PV is within comparison range 3 03 ON: Counter PV is within comparison range 4 04 ON: Counter PV is within comparison range 5 05 ON: Counter PV is within comparison range 6 06 ON: Counter PV is within comparison range 7 07 ON: Counter PV is within comparison range 8
	08	**High-speed Counter Comparison Operation** ON: Operating OFF: Stopped
	09	**High-speed Counter PV Overflow/Underflow Flag** ON: An overflow or underflow occurred. OFF: Normal operation
	10	Not used.
	11	**Pulse Output 0 Output Status** ON: Pulse output 0 is accelerating or decelerating. OFF: Pulse output 0 is operating at a constant rate.
	12	**Pulse Output 0 Overflow/Underflow Flag** ON: An overflow or underflow occurred. OFF: Normal operation
	13	**Pulse Output 0 Pulse Quantity Set Flag** ON: Pulse quantity has been set. OFF: Pulse quantity has not been set.
	14	**Pulse Output 0 Pulse Output Completed Flag** ON: Completed OFF: Not completed
	15	**Pulse Output 0 Output Status** ON: Pulses being output. OFF: Stopped.
AR 12 (Note 1)	00 to 11	Not used.
	12	**Pulse Output 1 Overflow/Underflow Flag** ON: An overflow or underflow occurred. OFF: Normal operation
	13	**Pulse Output 1 Pulse Quantity Set Flag** ON: Pulse quantity has been set. OFF: Pulse quantity has not been set.
	14	**Pulse Output 1 Pulse Output Completed Flag** ON: Completed OFF: Not completed
	15	**Pulse Output 1 Output Status** ON: Pulses being output. OFF: Stopped.

Word(s)	Bit(s)	Function
AR 13	00	**Power-up PC Setup Error Flag** Turns ON when there is an error in DM 6600 to DM 6614 (the part of the PC Setup area that is read at power-up).
	01	**Start-up PC Setup Error Flag** Turns ON when there is an error in DM 6615 to DM 6644 (the part of the PC Setup area that is read at the beginning of operation).
	02	**RUN PC Setup Error Flag** Turns ON when there is an error in DM 6645 to DM 6655 (the part of the PC Setup area that is always read).
	03, 04	Not used.
	05	**Cycle Time Too Long Flag** Turns ON if the actual cycle time is longer than the cycle time set in DM 6619.
	06, 07	Not used.
	08	**Memory Area Specification Error Flag** Turns ON when a non-existent data area address is specified in the program.
	09	**Flash Memory Error Flag** Turns ON when there is an error in flash memory.
	10	**Read-only DM Error Flag** Turns ON when a checksum error occurs in the read-only DM (DM 6144 to DM 6599) and that area is initialized.
	11	**PC Setup Error Flag** Turns ON when a checksum error occurs in the PC Setup area.
	12	**Program Error Flag** Turns ON when a checksum error occurs in the program memory (UM) area, or when an improper instruction is executed.
	13	**Expansion Instruction Area Error Flag** Turns ON when a checksum error occurs in the expansion instruction assignments area. The expansion instruction assignments will be cleared to their default settings.
	14	**Data Save Error Flag** Turns ON if data could not be retained with the backup battery. The following words are normally backed up by the battery: DM read/write words (DM 0000 to DM 1999 and DM 2022 to DM 2047), Error Log (DM 2000 to DM 2021), HR area, counter area, SR 25511, SR 25512 (if DM 6601 is set to hold I/O memory at startup), AR 23, operating mode (if DM 6600 is set to use the previous operating mode), and clock words (AR 17 to AR 21, for CPU Units with clocks). If the above words cannot be retained, all data will be cleared except that AR 2114 will be turned ON. The CPU Unit will start in PROGRAM mode if DM 6600 is set to use the previous operating mode. (If DM 6604 is set to generate an error, the PC will start in PROGRAM mode regardless.)
	15	**CompoBus/S ASIC Error Flag** Turns ON if an error occurred.
AR 14	00 to 15	**Maximum Cycle Time** (4 digits BCD, see note 2) The longest cycle time since the beginning of operation is stored. It is not cleared when operation stops, but it is cleared when operation starts again.
AR 15	00 to 15	**Current Cycle Time** (4 digits BCD, see note 2) The most recent cycle time during operation is stored. The Current Cycle Time is not cleared when operation stops.
AR 16	00 to 15	Not used.
AR 17	00 to 15	Not used.
AR 18	00 to 15	Not used.
AR 19	00 to 15	Not used.
AR 20	00 to 15	Not used.
AR 21	00 to 15	Not used.
AR 22	00 to 15	Not used.
AR 23	00 to 15	**Power-off Counter** (4 digits BCD) This is the count of the number of times that the power has been turned off. To clear the count, write “0000” from a Programming Device.

Note

1. The same data can be read immediately with PRV(62).
2. The units for the maximum and current cycle times are determined by the setting in bits 08 to 15 of DM 6618. A setting of 00 specifies 0.1-ms units, 01 specifies 0.1-ms units, 02 specifies 1-ms units, and 03 specifies 10-ms units.

4-6 PC Setup

4-6-1 Overview

The PC Setup (DM 6600 to DM 6655) contains various settings that control PC operation. Changes to the PC Setup are saved when the CPM2B-S is turned OFF, program execution is started, or program execution is stopped.

Always perform one of the following operations after changing the PC Setup:

- Switch the CPM2B-S to MONITOR mode or RUN mode.
- Turn the CPM2B-S OFF and then ON again.

Changing PC Setup Settings

The PC Setup (DM 6600 to DM 6655) can be edited from a Programming Device. The settings in DM 6600 to DM 6644 can be changed only when the PC is in PROGRAM mode. The settings in DM 6645 to DM 6655 can be changed when the PC is in PROGRAM mode or MONITOR mode, although the PC's cycle time will be quite long when the settings are changed in MONITOR mode.

CPU Unit Access of PC Setup Settings

The CPM2B-S CPU Unit reads parts of the PC Setup at different points of PC operation. The CPU Unit timing is as follows:

DM 6600 to DM 6614: Read once when the PC is turned ON.
DM 6615 to DM 6644: Read once at the start of program execution.
DM 6645 to DM 6655: Read regularly while the PC is ON.

PC Setup Errors

If there is an error in the PC Setup settings, a non-fatal error (error code 9B) will be generated when the CPU Unit accesses that part of the PC Setup. The PC Setup Error Flags (AR 1300 to AR 1302) indicate the part of the PC Setup where the error is located. The default setting (usually 0000) is used instead of the incorrect setting.

4-6-2 PC Setup Settings

Word(s)	Bit(s)	Function	
PC Startup Processing (DM 6600 to DM 6614)			
The following settings are read by the CPU when the PC is turned ON.			
DM 6600	00 to 07	Startup mode (effective when bits 08 to 15 are set to 02). 00 (Hex): PROGRAM; 01 (Hex): MONITOR; 02 (Hex): RUN	
	08 to 15	Startup mode designation 00 (Hex): According to the setting on DIP switch pin 4 and peripheral port connection (See table following this table.) 01 (Hex): Continue operating mode last used before power was turned OFF. 02 (Hex): Use setting in bits 00 to 07.	
DM 6601	00 to 07	Not used.	
	08 to 11	IOM Hold Bit (SR 25212) Status at Startup 0 (Hex): Reset to 0; 1 (Hex): Maintain previous status	
	12 to 15	Forced Status Hold Bit (SR 25211) Status at Startup 0 (Hex): Reset to 0; 1 (Hex): Maintain previous status	
DM 6602	00 to 03	Program memory write-protection 0 (Hex): Program memory unprotected 1 (Hex): Program memory write-protected (except DM 6602 itself)	
	04 to 07	Programming Console display language 0 (Hex): English; 1 (Hex): Japanese	
	08 to 11	Expansion instruction function code assignments 0 (Hex): Default settings 1 (Hex): User assignments	
	12 to 15	Not used.	
DM 6603	00 to 03	Maximum number of CompoBus/S nodes 0 (Hex): 256-point mode (32 nodes) 1 (Hex): 128-point mode (16 nodes)	
	04 to 07	CompoBus/S communications mode 0 (Hex): High-speed mode 1 (Hex): Long-distance mode	
	08 to 15	Not used.	
DM 6604	00 to 07	00 (Hex): A memory error will not be generated if data could not be retained by the battery. 01 (Hex): A memory error will be generated if data could not be retained by the battery.	
	08 to 15	Not used.	
DM 6605	00 to 03	DeviceNet Read/Write area settings 0 (Hex): Read area (IN) IR 020 to IR 027; Write area (OUT) IR 030 to IR 037 1 (Hex): Use settings in DM 6606 to DM 6609.	
	04 to 07	Transmission of CPM2B-S status to the DeviceNet Master 0 (Hex): Attach status information ahead of data. 1 (Hex): Do not attach status information ahead of data.	
	08 to 15	Not used.	
DM 6606	00 to 07	DeviceNet I/O Link Write (OUT) area settings (Master → CPM2B-S)	Data area 01 (Hex): I/O area 1 (IR 000 to IR 049) 02 (Hex): I/O area 2 (IR 200 to IR 227) 03 (Hex): DM area (DM 0000 to DM 2047) 04 (Hex): LR area (LR 00 to LR 15) 05 (Hex): HR area (HR 00 to HR 19) 07 (Hex): Timer/counter area (TC 000 to TC 255)
	08 to 15		Number of bytes 01 to 40 (Hex) (equivalent to 0 to 64 decimal)
DM 6607	00 to 15		Starting word address 0000 to 07FF (Hex) (equivalent to 0000 to 2047 decimal)

Word(s)	Bit(s)	Function	
DM 6608	00 to 07	DeviceNet I/O Link Read (IN) area settings (CPM2B-S → Master)	Data area 01 (Hex): I/O area 1 (IR 000 to IR 049) 02 (Hex): I/O area 2 (IR 200 to IR 227) 03 (Hex): DM area (DM 0000 to DM 2047) 04 (Hex): LR area (LR 00 to LR 15) 05 (Hex): HR area (HR 00 to HR 19) 06 (Hex): AR area (AR 00 to 23) 07 (Hex): Timer/counter area (TC 000 to TC 255)
	08 to 15		Number of bytes 01 to 40 (Hex) (equivalent to 0 to 64 decimal)
DM 6609	00 to 15		Starting word address 0000 to 07FF (Hex) (equivalent to 0000 to 2047 decimal)
DM 6610 to DM 6614	00 to 15	Not used.	Not used.

Note The startup operating mode will be as shown in the following table if bits 08 to 15 of DM 6600 are set to 00.

Connected Programming Device	Startup operating mode	
	DIP switch pin 4 ON	DIP switch pin 4 OFF
None	PROGRAM	RUN
Programming Console	Mode set on Programming Console mode switch	
Other Device	PROGRAM	

Word(s)	Bit(s)	Function
Cycle Time Settings (DM 6615 to DM 6619) The following settings are read by the CPU when program execution is started.		
DM 6615	00 to 15	Not used.
DM 6616	00 to 07	Servicing time for RS-232C port (Effective when bits 08 to 15 are set to 01.) 00 to 99 (BCD): Percentage of cycle time used to service RS-232C port.
	08 to 15	RS-232C port servicing setting enable 00 (Hex): 5% of the cycle time 01 (Hex): Use time in bits 00 to 07.
DM 6617	00 to 07	Servicing time for peripheral port (Effective when bits 08 to 15 are set to 01.) 00 to 99 (BCD): Percentage of cycle time used to service peripheral.
	08 to 15	Peripheral port servicing setting enable 00 (Hex): 5% of the cycle time 01 (Hex): Use time in bits 00 to 07.
DM 6618	00 to 07	Cycle monitor time (Effective when bits 08 to 15 are set to 01, 02, or 03.) 00 to 99 (BCD): Setting (See bits 08 to 15, below.) A fatal error will be generated and PC operation will stop if the cycle time exceeds the cycle monitor time set here.
	08 to 15	Cycle monitor enable (Setting in 00 to 07 × units; 99 s max.) 00 (Hex): 120 ms (setting in bits 00 to 07 disabled) 01 (Hex): Setting units: 10 ms 02 (Hex): Setting units: 100 ms 03 (Hex): Setting units: 1 s
DM 6619	00 to 15	Minimum cycle time 0000: Variable (no minimum) 0001 to 9999 (BCD): Minimum time in ms

Word(s)	Bit(s)	Function
Interrupt Processing (DM 6620 to DM 6639)		
The following settings are read by the CPU when program execution is started.		
DM 6620	00 to 03	Input time constant for IR 00000 to IR 00002 0 (Hex): 10 ms; 1 (Hex): 1 ms; 2 (Hex): 2 ms; 3 (Hex): 3 ms; 4 (Hex): 5 ms; 5 (Hex): 10 ms; 6 (Hex): 20 ms; 7 (Hex): 40 ms; 8 (Hex): 80 ms
	04 to 07	Input time constant for IR 00003 and IR 00004 (Setting same as bits 00 to 03)
	08 to 11	Input time constant for IR 00005 (Setting same as bits 00 to 03)
	12 to 15	Not used.
DM 6621	00 to 15	Not used.
DM 6622	00 to 07	Input constant for IR 003 00 (Hex): 10 ms 01 (Hex): 1 ms 02 (Hex): 2 ms 03 (Hex): 3 ms 04 (Hex): 5 ms 05 (Hex): 10 ms 06 (Hex): 20 ms 07 (Hex): 40 ms 08 (Hex): 80 ms
	08 to 15	Input constant for IR 004 (Setting same as for IR 001.)
DM 6623	00 to 07	Input constant for IR 005 (Setting same as for IR 001.)
	08 to 15	Not used.
DM 6624	00 to 15	Not used.
DM 6625	00 to 15	Not used.
DM 6626 to DM 6627	00 to 15	Not used.
DM 6628	00 to 03	Function selection for input bit IR 00003 0 (Hex): Used as a normal input. 1 (Hex): Used as an interrupt input (including counter mode). 2 (Hex): Used as a quick-response input.
	04 to 07	Function selection for input bit IR 00004 (Setting same as for IR 00003.)
	08 to 15	Not used.
DM 6629	00 to 03	PV coordinate system for pulse output 0 0 (Hex): Relative coordinates; 1 (Hex): Absolute coordinates
	04 to 07	PV coordinate system for pulse output 1 0 (Hex): Relative coordinates; 1 (Hex): Absolute coordinates
	08 to 15	Not used.
DM 6630 to DM 6639	00 to 15	Not used.
High-speed Counter Settings (DM 6640 to DM 6644)		
The following settings are read by the CPU when program execution is started.		
DM 6640 to DM 6641	00 to 15	Not used.
DM 6642	00 to 03	High-speed counter mode 0 (Hex): Differential phase mode (5 kHz) 1 (Hex): Pulse + direction input mode (20 kHz) 2 (Hex): Up/down input mode (20 kHz) 4 (Hex): Increment mode (20 kHz)
	04 to 07	High-speed counter reset mode 0: Z phase and software reset; 1: Software reset only
	08 to 15	High-speed counter/Synchronized pulse control for IR 00000 to IR 00002 00 (Hex): Don't use either function. 01 (Hex): Use as high-speed counters. 02 (Hex): Use for synchronized pulse control (10 to 500 Hz). 03 (Hex): Use for synchronized pulse control (20 Hz to 1 kHz). 04 (Hex): Use for synchronized pulse control (300 Hz to 20 kHz).
DM 6643, DM 6644	00 to 15	Not used.

Word(s)	Bit(s)	Function
RS-232C Port Communications Settings		
The following settings are read regularly by the CPU while the PC is ON.		
If pin 3 of the CPM2B-S CPU Unit's DIP switch is ON, communications through the CPM2B-S' RS-232C port are governed by the default settings (all 0) regardless of the settings in DM 6645 through DM 6649.		
DM 6645	00 to 03	Port settings 0 (Hex): Standard (1 start bit, 7 data bits, even parity, 2 stop bits, 9,600 bps), Host Link unit number: 0 1 (Hex): Settings in DM 6646 (Any other setting will cause a non-fatal error and AR 1302 will turn ON.)
	04 to 07	CTS control setting 0 (Hex): Disable CTS control; 1 (Hex): Enable CTS control (Any other setting will cause a non-fatal error and AR 1302 will turn ON.)
	08 to 11	Link words for 1:1 data link 0 (Hex): LR 00 to LR 15 (Any other settings are ineffective.)
	12 to 15	Communications mode 0 (Hex): Host Link; 1 (Hex): No-protocol; 2 (Hex): 1:1 PC Link Slave; 3 (Hex): 1:1 PC Link Master; 4 (Hex): NT Link (Any other setting causes a non-fatal error and turns ON AR 1302.)
DM 6646	00 to 07	Baud rate 00 (Hex): 1,200 bps; 01 (Hex): 2,400 bps; 02 (Hex): 4,800 bps; 03 (Hex): 9,600 bps; 04 (Hex): 19,200 bps
	08 to 15	Frame format Start bits / Data bits / Stop bits / Parity 00 (Hex): 1 bit / 7 bits / 1 bit / Even 01 (Hex): 1 bit / 7 bits / 1 bit / Odd 02 (Hex): 1 bit / 7 bits / 1 bit / None 03 (Hex): 1 bit / 7 bits / 2 bits / Even 04 (Hex): 1 bit / 7 bits / 2 bits / Odd 05 (Hex): 1 bit / 7 bits / 2 bits / None 06 (Hex): 1 bit / 8 bits / 1 bit / Even 07 (Hex): 1 bit / 8 bits / 1 bit / Odd 08 (Hex): 1 bit / 8 bits / 1 bit / None 09 (Hex): 1 bit / 8 bits / 2 bits / Even 10 (Hex): 1 bit / 8 bits / 2 bits / Odd 11 (Hex): 1 bit / 8 bits / 2 bits / None (Any other setting specifies standard settings (1 start bit, 7 data bits; even parity, 2 stop bits, 9,600 bps), causes a non-fatal error, and turns ON AR 1302.)
DM 6647	00 to 15	Transmission delay (0000 to 9999 BCD sets a delay of 0 to 99,990 ms.) (Any other setting specifies a delay of 0 ms, causes a non-fatal error, and turns ON AR 1302.)
DM 6648	00 to 07	Node number (Host Link) 00 to 31 (BCD) (Any other setting specifies a node number of 00, causes a non-fatal error, and turns ON AR 1302.)
	08 to 11	Start code selection for no-protocol communications 0 (Hex): Disables start code; 1 (Hex): Enables start code in DM 6649 (Any other setting disables the start code, causes a non-fatal error, and turns ON AR 1302.)
	12 to 15	End code selection for no-protocol communications 0 (Hex): Disables end code; 1 (Hex): Enables end code in DM 6649; 2 (Hex): Sets end code of CR, LF. (Any other setting disables the end code, causes a non-fatal error, and turns ON AR 1302.)
DM 6649	00 to 07	Start code (00 to FF) (This setting is valid only when bits 8 to 11 of DM 6648 are set to 1.)
	08 to 15	When bits 12 to 15 of DM 6648 set to 0: Sets the number of bytes to receive. (00: 256 bytes; 01 to FF: 1 to 255 bytes) When bits 12 to 15 of DM 6648 set to 1: Sets the end code. (00 to FF)

Word(s)	Bit(s)	Function
Peripheral Port Communications Settings		
The following settings are read regularly by the CPU while the PC is ON.		
If pin 3 of the CPM2B-S CPU Unit's DIP switch is ON, communications through the CPM2B-S' peripheral port are governed by the default settings (all 0) regardless of the settings in DM 6650 through DM 6654.		
When connecting a computer running OMRON Support Software to the peripheral bus, turn OFF pin 3 of the DIP switch and set DM 6650 to 0001 (host link port settings specified in DM 6651). The computer cannot be connected to the peripheral bus if bits 00 to 03 of DM 6650 are set to 0 (standard port settings).		
DM 6650	00 to 03	Port settings 00 (Hex): Standard (1 start bit, 7 data bits, even parity, 2 stop bits, 9,600 bps), Host Link unit number: 0 01 (Hex): Settings in DM 6651 (Any other setting specifies standard settings, causes a non-fatal error, and turns ON AR 1302.)
	04 to 11	Not used.
	12 to 15	Communications mode 0 (Hex): Host Link or peripheral bus; 1 (Hex): No-protocol (Any other setting specifies Host Link, causes a non-fatal error, and turns ON AR 1302.)
DM 6651	00 to 07	Baud rate 00 (Hex): 1,200 bps; 01 (Hex): 2,400 bps; 02 (Hex): 4,800 bps; 03 (Hex): 9,600 bps; 04 (Hex): 19,200 bps
	08 to 15	Frame format 00 (Hex): 1 bit, 7 bits, 1 bit, Even 01 (Hex): 1 bit, 7 bits, 1 bit, Odd 02 (Hex): 1 bit, 7 bits, 1 bit, None 03 (Hex): 1 bit, 7 bits, 2 bits, Even 04 (Hex): 1 bit, 7 bits, 2 bits, Odd 05 (Hex): 1 bit, 7 bits, 2 bits, None 06 (Hex): 1 bit, 8 bits, 1 bit, Even 07 (Hex): 1 bit, 8 bits, 1 bit, Odd 08 (Hex): 1 bit, 8 bits, 1 bit, None 09 (Hex): 1 bit, 8 bits, 2 bits, Even 10 (Hex): 1 bit, 8 bits, 2 bits, Odd 11 (Hex): 1 bit, 8 bits, 2 bits, None (Any other setting specifies standard settings (1 start bit, 7 data bits; even parity, 2 stop bits, 9,600 bps), causes a non-fatal error, and turns ON AR 1302.)
DM 6652	00 to 15	Transmission delay (0000 to 9999 BCD sets a delay of 0 to 99,990 ms.) (Any other setting specifies a delay of 0 ms, causes a non-fatal error, and turns ON AR 1302.)
DM 6653	00 to 07	Node number (Host Link) 00 to 31 (BCD) (Any other setting specifies a node number of 00, causes a non-fatal error, and turns ON AR 1302.)
	08 to 11	Start code selection for no-protocol communications 0 (Hex): Disables start code; 1 (Hex): Enables start code in DM 6649 (Any other setting disables the start code, causes a non-fatal error, and turns ON AR 1302.)
	12 to 15	End code selection for no-protocol communications 0 (Hex): Disables end code; 1 (Hex): Enables end code in DM 6649; 2 (Hex): Sets end code of CR, LF. (Any other setting disables the end code, causes a non-fatal error, and turns ON AR 1302.)
DM 6654	00 to 07	Start code (00 to FF) (This setting is valid only when bits 8 to 11 of DM 6648 are set to 1.)
	08 to 15	When bits 12 to 15 of DM 6648 set to 0: Sets the number of bytes to receive. (00: 256 bytes; 01 to FF: 1 to 255 bytes) When bits 12 to 15 of DM 6648 set to 1: Sets the end code. (00 to FF)

Word(s)	Bit(s)	Function
Error Detection and Error Log Operation (DM 6655) The following settings are read regularly by the CPU while the PC is ON.		
DM 6655	00 to 03	Style 0 (Hex): Shift after 7 records have been stored 1 (Hex): Store only first 7 records (no shifting) 2 to F (Hex): Do not store records
	04 to 07	Not used.
	08 to 11	Cycle time monitor enable 0 (Hex): Generate a non-fatal error for a cycle time that is too long. 1 (Hex): Do not generate a non-fatal error.
	12 to 15	Low battery error enable (This setting is valid only when the low battery detection switch is ON.) 0 (Hex): Generate a non-fatal error for low battery voltage. 1 (Hex): Do not generate a non-fatal error.

Note If an out-of-range value is set, the following communications conditions will result. In that case, reset the value so that it is within the permissible range.

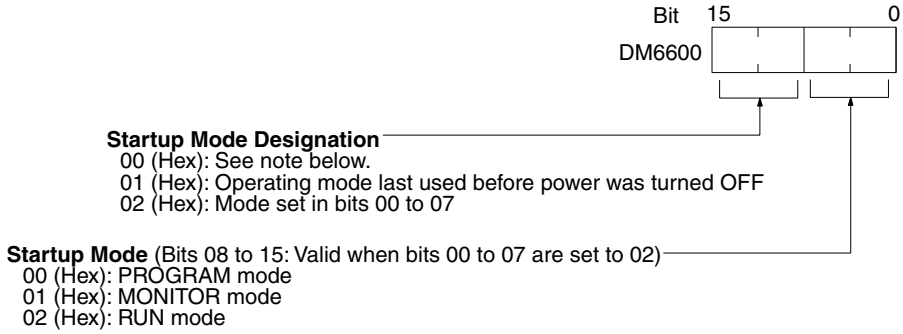
Communications mode:	Host Link
Communications format:	Standard settings (1 start bit, 7-bit data; even parity, 2 stop bits, 9,600 bps)
Transmission delay:	No
Node number:	00

4-7 Basic PC Operation and I/O Processes

This section explains the PC Setup settings related to basic operation and I/O processes.

4-7-1 Startup Mode

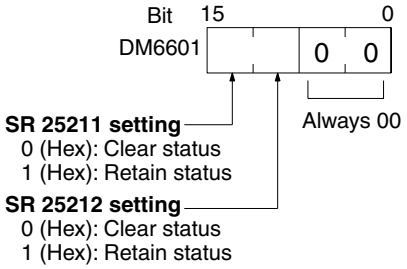
The operating mode the PC will start in when power is turned on can be set as shown below.


Bit 15 0
DM6600
Startup Mode Designation
00 (Hex): See note below.
01 (Hex): Operating mode last used before power was turned OFF
02 (Hex): Mode set in bits 00 to 07
Startup Mode (Bits 08 to 15: Valid when bits 00 to 07 are set to 02)
00 (Hex): PROGRAM mode
01 (Hex): MONITOR mode
02 (Hex): RUN mode

Note When the “startup mode designation” is set to 00, the operating mode at startup depends upon the connected Programming Device and the setting on pin 4 of the CPM2B-S CPU Board’s DIP switch.
Refer to *1-3-3 Operating Mode at Startup* for complete details.

4-7-2 Hold Bit Status

Make the settings shown below to determine whether, when the power supply is turned on, the Forced Status Hold Bit (SR 25211) and/or IOM Hold Bit (SR 25212) will retain the status that was in effect when the power was last turned off, or whether the previous status will be cleared.



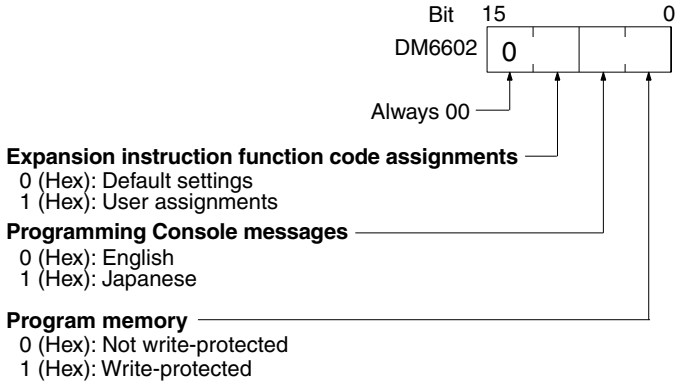
Default: Clear both.

The Forced Status Hold Bit (SR 25211) determines whether or not the forced set/reset status is retained when changing from PROGRAM mode to MONITOR mode.

The IOM Hold Bit (SR 25212) determines whether or not the status of IR bits and LR bits is retained when PC operation is started and stopped.

4-7-3 Program Memory Write-protection

In CPM2B-S PCs, the program memory can be protected by setting bits 00 to 03 of DM 6602 to 1. Bits 04 to 07 determine whether Programming Console messages are displayed in English or Japanese.

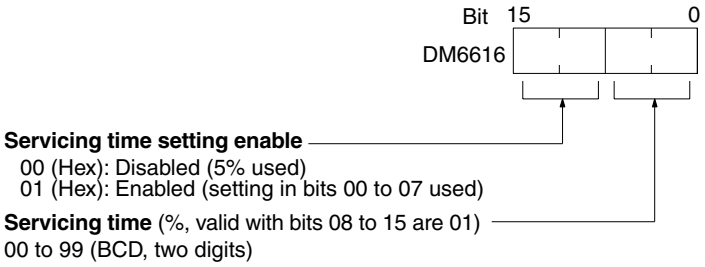


Default: English displays, not write-protected

Note DM 6602 itself can still be changed after the program memory has been write-protected by setting bits 04 to 07 of DM 6602 to 1.

4-7-4 RS-232C Port Servicing Time

The following settings are used to determine the percentage of the cycle time devoted to servicing the RS-232C port.


Bit 15 0
DM6616
Servicing time setting enable
00 (Hex): Disabled (5% used)
01 (Hex): Enabled (setting in bits 00 to 07 used)
Servicing time (%, valid with bits 08 to 15 are 01)
00 to 99 (BCD, two digits)
Default: 5% of cycle time

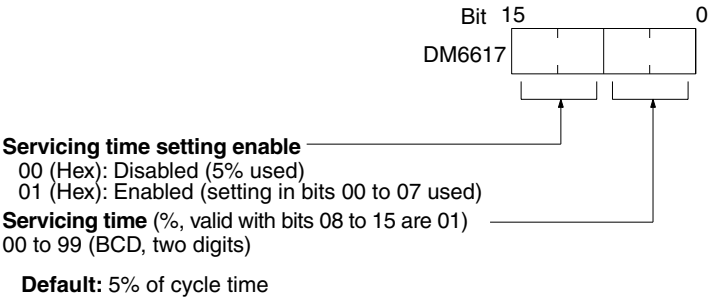
For example, if DM 6616 is set to 0110, the RS-232C port will be serviced for 10% of the cycle time.

The servicing time will be 0.34 ms minimum.

The entire servicing time will not be used unless processing requests exist.

4-7-5 Peripheral Port Servicing Time

The following settings are used to determine the percentage of the cycle time devoted to servicing the peripheral port.

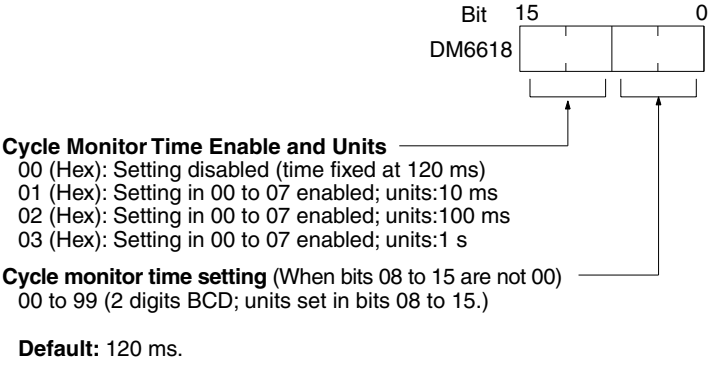

Bit 15 0
DM6617
Servicing time setting enable
00 (Hex): Disabled (5% used)
01 (Hex): Enabled (setting in bits 00 to 07 used)
Servicing time (%, valid with bits 08 to 15 are 01)
00 to 99 (BCD, two digits)
Default: 5% of cycle time

For example, if DM 6617 is set to 0115, the peripheral port will be serviced for 15% of the cycle time.

The servicing time will be 0.34 ms minimum.

The entire servicing time will not be used unless processing requests exist.

4-7-6 Cycle Monitor Time


Bit 15 0
DM6618
Cycle Monitor Time Enable and Units
00 (Hex): Setting disabled (time fixed at 120 ms)
01 (Hex): Setting in 00 to 07 enabled; units:10 ms
02 (Hex): Setting in 00 to 07 enabled; units:100 ms
03 (Hex): Setting in 00 to 07 enabled; units:1 s
Cycle monitor time setting (When bits 08 to 15 are not 00)
00 to 99 (2 digits BCD; units set in bits 08 to 15.)
Default: 120 ms.

The cycle monitor time is used for checking for extremely long cycle times, as can happen when the program goes into an infinite loop. If the cycle time exceeds the cycle monitor setting, a fatal error (FALS 9F) will be generated.

Note

1. The units used for the maximum and current cycle times recorded in the AR area (AR 14 and AR 15) are determined by the setting for the cycle monitor time in DM 6618, as shown below.

   Bits 08 to 15 set to 01 (Hex):0.1 ms
   Bits 08 to 15 set to 02 (Hex):1 ms
   Bits 08 to 15 set to 03 (Hex):10 ms

2. If the cycle time is 1 s or longer, the cycle time read from Programming Devices will be 999.9 ms. The correct maximum and current cycle times will be recorded in the AR area.

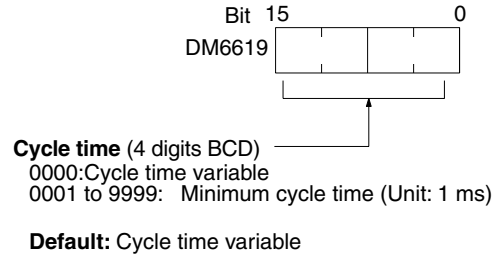
Example

If 0230 is set in DM 6618, an FALS 9F error will not occur until the cycle time exceeds 3 s. If the actual cycle time is 2.59 s, the current cycle time stored in the AR area will be 2590 (ms), but the cycle time read from a Programming Device will be 999.9 ms.

A "cycle time over" error (non-fatal) will be generated when the cycle time exceeds 100 ms unless detection of long cycle times is disabled using the setting in DM 6655.

4-7-7 Minimum Cycle Time

Make the settings shown below to standardize the cycle time and to eliminate variations in I/O response time by setting a minimum cycle time.

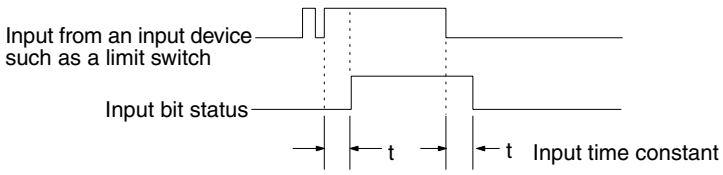


If the actual cycle time is shorter than the minimum cycle time, execution will wait until the minimum time has expired. If the actual cycle time is longer than the minimum cycle time, then operation will proceed according to the actual cycle time. AR 2405 will turn ON if the minimum cycle time is exceeded.

4-7-8 Input Time Constants

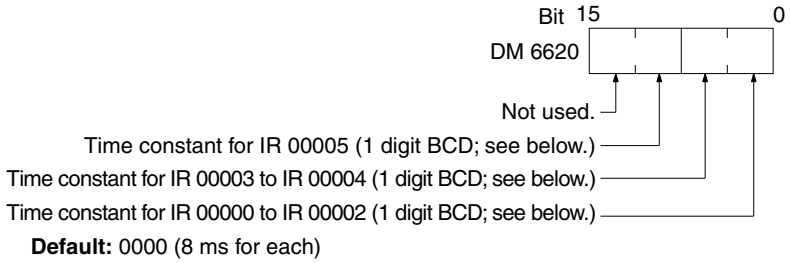
Make the settings shown below to set the time from when the actual inputs from the DC Input Unit are turned ON or OFF until the corresponding input bits are updated (i.e., until their ON/OFF status is changed). Make these settings when you want to adjust the time until inputs stabilize.

Increasing the input time constant can reduce the effects from chattering and external noise.

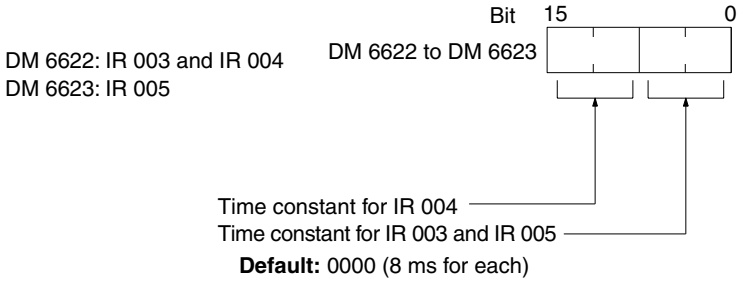


Use a Programming Device to set the input time constants.

Input Time Constants for IR 000


Bit 15
0
DM 6620
Not used.
Time constant for IR 00005 (1 digit BCD; see below.)
Time constant for IR 00003 to IR 00004 (1 digit BCD; see below.)
Time constant for IR 00000 to IR 00002 (1 digit BCD; see below.)
Default: 0000 (8 ms for each)

Input Time Constants for IR 003 to IR 005


Bit 15
0
DM 6622: IR 003 and IR 004
DM 6623: IR 005
DM 6622 to DM 6623
Time constant for IR 004
Time constant for IR 003 and IR 005
Default: 0000 (8 ms for each)

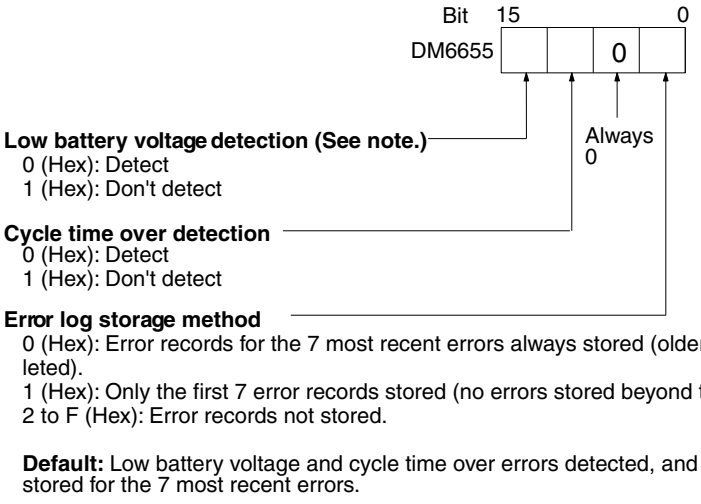
The nine possible settings for the input time constant are shown below. (Set only the rightmost digit for each setting for IR 000.)

00 (Hex): 8 ms 01 (Hex): 1 ms 02 (Hex): 2 ms
03 (Hex): 4 ms 04 (Hex): 8 ms 05 (Hex): 16 ms
06 (Hex): 32 ms 07 (Hex): 64 ms 08 (Hex): 128 ms

4-7-9 Error Detection and Error Log Settings

Error Detection and Error Log Operation (DM 6655)

Make the settings shown below to determine whether or not a non-fatal error is to be generated when the cycle time exceeds 100 ms or when the voltage of the built-in battery drops, and to set the method for storing records in the error log when errors occur.


Bit 15
0
DM6655
0
Always 0
Low battery voltage detection (See note.)
0 (Hex): Detect
1 (Hex): Don't detect
Cycle time over detection
0 (Hex): Detect
1 (Hex): Don't detect
Error log storage method
0 (Hex): Error records for the 7 most recent errors always stored (older errors deleted).
1 (Hex): Only the first 7 error records stored (no errors stored beyond that point).
2 to F (Hex): Error records not stored.
Default: Low battery voltage and cycle time over errors detected, and error records stored for the 7 most recent errors.

Battery errors and cycle time overrun errors are non-fatal errors.

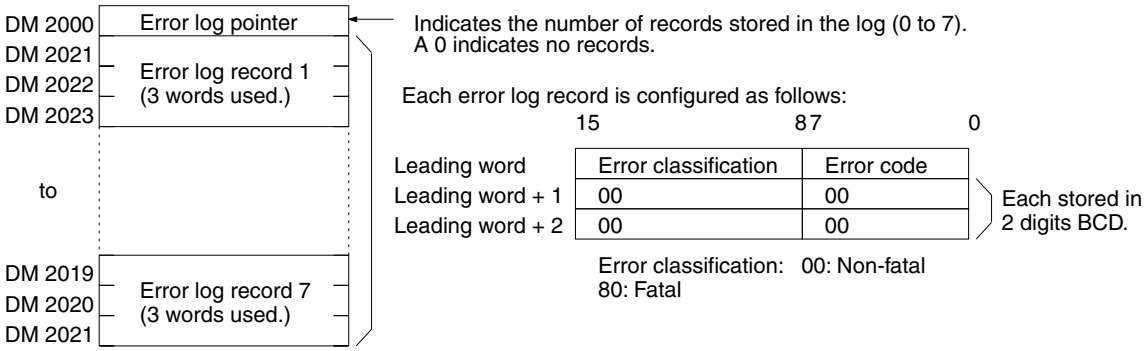
Refer to *4-8 Error Log* below for details on the error log.

Note Low battery detection is enabled only when the low battery detection switch is ON. (See page 31.)

4-8 Error Log

The error log function registers the error code of any fatal or non-fatal error that occurs in the PC. The date and time at which the error occurred are registered as all zeros (00).

In CPM2B-S PCs, the error log is stored in DM 2000 through DM 2021. Up to 7 error records can be stored.

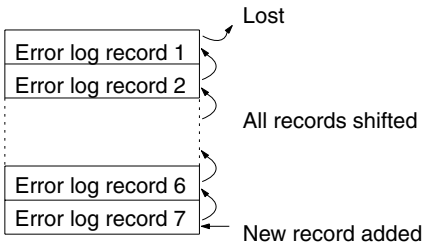


Note An error record with an error code of 00 will be stored in the error log for power interruptions. Refer to *9-2 Self-diagnostic Functions* for tables listing the error codes.

Error Log Storage Methods

The error log storage method is set in the PC Setup (bits 00 to 03 of DM 6655). Set any of the following methods.

1,2,3... 1. Set 0 in bits 00 to 03 of DM 6655. (This is the default setting.)
This method stores the most recent 7 error log records and discards older records. This is achieved by shifting the records as shown below so that the oldest record (record 0) is lost whenever a new record is generated.



2. Set 1 in bits 00 to 03 of DM 6655.
This method stores only the first 7 error log records, and ignores any subsequent errors beyond those 7.
3. Set another value (other than 0 or 1) in bits 00 to 03 of DM 6655.
A setting other than 0 or 1 disables the log so that no records are stored.

Clearing the Error Log

To clear the entire error log, turn ON SR 25214 from a Programming Device. (After the error log has been cleared, SR 25214 will turn OFF again automatically.)

SECTION 5
Instruction Set

The CPM2B-S PCs have large a programming instruction set that allows for easy programming of complicated control processes. This section provides a brief summary of the instruction set.

5-1 CPM2B-S Function Codes 86
5-2 Alphabetic List by Mnemonic 87
5-3 Expansion Instructions 90

5-1 CPM2B-S Function Codes

The following table lists the CPM2B-S instructions that have fixed function codes. Each instruction is listed by mnemonic and by instruction name. Use the numbers in the leftmost column as the left digit and the number in the column heading as the right digit of the function code.

Left digit	Right digit									
	0	1	2	3	4	5	6	7	8	9
0	**NOP** NO OPERATION	**END** END	**IL** INTERLOCK	**ILC** INTERLOCK CLEAR	**JMP** JUMP	**JME** JUMP END	**(@) FAL** FAILURE ALARM AND RESET	**FALS** SEVERE FAILURE ALARM	**STEP** STEP DEFINE	**SNXT** STEP START
1	**SFT** SHIFT REGISTER	**KEEP** KEEP	**CNTR** REVERSIBLE COUNTER	**DIFU** DIFFERENTIATE UP	**DIFD** DIFFERENTIATE DOWN	**TIMH** HIGH-SPEED TIMER	**(@) WSFT** WORD SHIFT	**(@) ASFT** ASYNCHRONOUS SHIFT REGISTER	---	---
2	**CMP** COMPARE	**(@) MOV** MOVE	**(@) MVN** MOVE NOT	**(@) BIN** BCD TO BINARY	**(@) BCD** BINARY TO BCD	**(@) ASL** SHIFT LEFT	**(@) ASR** SHIFT RIGHT	**(@) ROL** ROTATE LEFT	**(@) ROR** ROTATE RIGHT	**(@) COM** COMPLEMENT
3	**(@) ADD** BCD ADD	**(@) SUB** BCD SUBTRACT	**(@) MUL** BCD MULTIPLY	**(@) DIV** BCD DIVIDE	**(@) ANDW** LOGICAL AND	**(@) ORW** LOGICAL OR	**(@) XORW** EXCLUSIVE OR	**(@) XNRW** EXCLUSIVE NOR	**(@) INC** INCREMENT	**(@) DEC** DECREMENT
4	**(@) STC** SET CARRY	**(@) CLC** CLEAR CARRY	---	---	---	---	**(@) MSG** MESSAGE DISPLAY	**(@) RXD** RECEIVE	**(@) TXD** TRANSMIT	---
5	**(@) ADB** BINARY ADD	**(@) SBB** BINARY SUBTRACT	**(@) MLB** BINARY MULTIPLY	**(@) DVB** BINARY DIVIDE	**(@) ADDL** DOUBLE BCD ADD	**(@) SUBL** DOUBLE BCD SUBTRACT	**(@) MULL** DOUBLE BCD MULTIPLY	**(@) DIVL** DOUBLE BCD DIVIDE	**(@) BINL** DOUBLE BCD-TO-DOUBLE BINARY	**(@) BCDL** DOUBLE BINARY-TO-DOUBLE BCD
6	**CMPL** DOUBLE COMPARE	**(@) INI** MODE CONTROL	**(@) PRV** HIGH-SPEED COUNTER PV READ	**(@) CTBL** COMPARISON TABLE LOAD	**(@) SPED** SPEED OUTPUT	**(@) PULS** SET PULSES	**(@) SCL** SCALING	**(@) BCNT** BIT COUNTER	**(@) BCMP** BLOCK COMPARE	**(@) STIM** INTERVAL TIMER
7	**(@) XFER** BLOCK TRANSFER	**(@) BSET** BLOCK SET	---	**(@) XCHG** DATA EXCHANGE	**(@) SLD** ONE DIGIT SHIFT LEFT	**(@) SRD** ONE DIGIT SHIFT RIGHT	**(@) MLPX** 4-TO-16 DECODER	**(@) DMPX** 16-TO-4 ENCODER	**(@) SDEC** 7-SEGMENT DECODER	---
8	**(@) DIST** SINGLE WORD DISTRIBUTE	**(@) COLL** DATA COLLECT	**(@) MOVB** MOVE BIT	**(@) MOVD** MOVE DIGIT	**(@) SFTR** REVERSIBLE SHIFT REGISTER	**(@) TCMP** TABLE COMPARE	**(@) ASC** ASCII CONVERT	---	---	**(@) INT** INTERRUPT CONTROL
9	---	**(@) SBS** SUBROUTINE ENTRY	**SBN** SUBROUTINE DEFINE	**RET** SUBROUTINE RETURN	---	---	---	**(@) IORF** I/O REFRESH	---	**(@) MCRO** MACRO

Note

1. The shaded areas are function codes to which expansion instructions are allocated by default or to which the user can allocate expansion instructions. Refer to *5-3 Expansion Instructions* for more details.
2. Instruction execution times are the same as those for the CPM2A and CPM2C. Refer to the *Programming Manual* (W353) for details.

5-2 Alphabetic List by Mnemonic

Dashes ("– –") in the *Code* column indicate expansion instructions, which do not have fixed function codes. "None" indicates instructions for which function codes are not used.

Mnemonic	Code	Words	Name
ACC (@)	– –	4	ACCELERATION CONTROL
ADB (@)	50	4	BINARY ADD
ADD (@)	30	4	BCD ADD
ADDL (@)	54	4	DOUBLE BCD ADD
AND	None	1	AND
AND LD	None	1	AND LOAD
AND NOT	None	1	AND NOT
ANDW (@)	34	4	LOGICAL AND
ASC (@)	86	4	ASCII CONVERT
ASFT(@)	17	4	ASYNCHRONOUS SHIFT REGISTER
ASL (@)	25	2	ARITHMETIC SHIFT LEFT
ASR (@)	26	2	ARITHMETIC SHIFT RIGHT
AVG	– –	4	AVERAGE VALUE
BCD (@)	24	3	BINARY TO BCD
BCDL (@)	59	3	DOUBLE BINARY-TO-DOUBLE BCD
BCMP (@)	68	4	BLOCK COMPARE
BCNT (@)	67	4	BIT COUNTER
BIN (@)	23	3	BCD-TO-BINARY
BINL (@)	58	3	DOUBLE BCD-TO-DOUBLE BINARY
BSET (@)	71	4	BLOCK SET
CLC (@)	41	1	CLEAR CARRY
CMP	20	3	COMPARE
CMPL	60	4	DOUBLE COMPARE
CNT	None	2	COUNTER
CNTR	12	3	REVERSIBLE COUNTER
COLL (@)	81	4	DATA COLLECT
COM (@)	29	2	COMPLEMENT
CTBL(@)	63	4	COMPARISON TABLE LOAD
DEC (@)	39	2	BCD DECREMENT
DIFD	14	2	DIFFERENTIATE DOWN
DIFU	13	2	DIFFERENTIATE UP
DIST (@)	80	4	SINGLE WORD DISTRIBUTE
DIV (@)	33	4	BCD DIVIDE
DIVL (@)	57	4	DOUBLE BCD DIVIDE
DMPX (@)	77	4	16-TO-4 ENCODER
DVB (@)	53	4	BINARY DIVIDE
END	01	1	END
FAL (@)	06	2	FAILURE ALARM AND RESET
FALS	07	2	SEVERE FAILURE ALARM
FCS (@)	– –	4	FCS CALCULATE
HEX (@)	– –	4	ASCII-TO-HEXADECIMAL
HMS	– –	4	SECONDS TO HOURS
IL	02	1	INTERLOCK
ILC	03	1	INTERLOCK CLEAR

Mnemonic	Code	Words	Name
INC (@)	38	2	INCREMENT
INI (@)	61	4	MODE CONTROL
INT (@)	89	4	INTERRUPT CONTROL
IORF (@)	97	3	I/O REFRESH
JME	05	2	JUMP END
JMP	04	2	JUMP
KEEP	11	2	KEEP
LD	None	1	LOAD
LD NOT	None	1	LOAD NOT
MAX (@)	– –	4	FIND MAXIMUM
MCRO (@)	99	4	MACRO
MIN (@)	– –	4	FIND MINIMUM
MLB (@)	52	4	BINARY MULTIPLY
MLPX (@)	76	4	4-TO-16 DECODER
MOV (@)	21	3	MOVE
MOVB (@)	82	4	MOVE BIT
MOVD (@)	83	4	MOVE DIGIT
MSG (@)	46	2	MESSAGE
MUL (@)	32	4	BCD MULTIPLY
MULL (@)	56	4	DOUBLE BCD MULTIPLY
MVN (@)	22	3	MOVE NOT
NEG (@)	– –	4	2'S COMPLEMENT
NOP	00	1	NO OPERATION
OR	None	1	OR
OR LD	None	1	OR LOAD
OR NOT	None	1	OR NOT
ORW (@)	35	4	LOGICAL OR
OUT	None	2	OUTPUT
OUT NOT	None	2	OUTPUT NOT
PID	– –	4	PID CONTROL
PRV (@)	62	4	HIGH-SPEED COUNTER PV READ
PULS (@)	65	4	SET PULSES
PWM (@)	– –	4	PULSE WITH VARIABLE DUTY RATIO
RET	93	1	SUBROUTINE RETURN
ROL (@)	27	2	ROTATE LEFT
ROR (@)	28	2	ROTATE RIGHT
RSET	None	2	RESET
RXD (@)	47	4	RECEIVE
SBB (@)	51	4	BINARY SUBTRACT
SBN	92	2	SUBROUTINE DEFINE
SBS (@)	91	2	SUBROUTINE ENTRY
SCL (@)	66	4	SCALING
SCL2 (@)	– –	4	SIGNED BINARY TO BCD SCALING
SCL3 (@)	– –	4	BCD TO SIGNED BINARY SCALING
SDEC (@)	78	4	7-SEGMENT DECODER
SEC	– –	4	HOURS TO SECONDS
SET	None	2	SET
SFT	10	3	SHIFT REGISTER
SFTR (@)	84	4	REVERSIBLE SHIFT REGISTER

Mnemonic	Code	Words	Name
SLD (@)	74	3	ONE DIGIT SHIFT LEFT
SNXT	09	2	STEP START
SPED (@)	64	4	SPEED OUTPUT
SRCH (@)	– –	4	DATA SEARCH
SRD (@)	75	3	ONE DIGIT SHIFT RIGHT
STC (@)	40	1	SET CARRY
STEP	08	2	STEP DEFINE
STIM (@)	69	4	INTERVAL TIMER
STUP	– –	3	CHANGE RS-232C SETUP
SUB (@)	31	4	BCD SUBTRACT
SUBL (@)	55	4	DOUBLE BCD SUBTRACT
SUM (@)	– –	4	SUM
SYNC (@)	– –	4	SYNCHRONIZED PULSE CONTROL
TCMP (@)	85	4	TABLE COMPARE
TIM	None	2	TIMER
TIMH	15	3	HIGH-SPEED TIMER
TIML	– –	4	LONG TIMER
TMHH	– –	4	VERY HIGH-SPEED TIMER
TXD (@)	48	4	TRANSMIT
WSFT (@)	16	3	WORD SHIFT
XCHG (@)	73	3	DATA EXCHANGE
XFER (@)	70	4	BLOCK TRANSFER
XNRW (@)	37	4	EXCLUSIVE NOR
XORW (@)	36	4	EXCLUSIVE OR
ZCP	– –	4	AREA RANGE COMPARE
ZCPL	– –	4	DOUBLE AREA RANGE COMPARE

5-3 Expansion Instructions

A set of expansion instructions is provided to aid in special programming needs. Function codes can be assigned to up to 18 of the expansion instructions to enable using them in programs. This allows the user to pick the instructions needed by each program to more effectively use the function codes required to input instructions.

The mnemonics of expansion instructions are followed by "(– –)" as the function code to indicate that they must be assigned function codes by the user in the instructions table before they can be used in programming (unless they are used under their default settings).

Refer to the *6-2-5 Assigning Expansion Instruction Function Codes of SYSMAC CPM2B Programmable Controller Operation Manual* (W371) for a description of the Programming Console operations used to change expansion instruction allocations.

Refer to the *SYSMAC Support Software Operation Manuals: C-series PCs* (W248), the *SYSMAC-CPT Support Software User Manual* (W333), or the *WS02-CXPC1-E CX-Programmer User Manual* (W361) for a description of the corresponding Support Software operations.

Function Codes for Expansion Instructions

The following 18 function codes can be used for expansion instructions:
17, 18, 19, 47, 48, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 87, 88, and 89

The 35 expansion instructions that can be used are listed below, along with the default function codes that are assigned when the CPM2B-S is shipped.

Mnemonic	Code
ASFT (@)	17
(open)	18
(open)	19
RXD (@)	47
TXD (@)	48
CMPL	60
INI (@)	61
PRV (@)	62
CTBL (@)	63
SPED (@)	64
PULS (@)	65
SCL (@)	66
BCNT (@)	67

Mnemonic	Code
BCMP (@)	68
STIM (@)	69
(open)	87
(open)	88
INT (@)	89
ACC (@)	---
AVG	---
FCS (@)	---
HEX (@)	---
HMS (@)	---
MAX (@)	---
MIN (@)	---
NEG (@)	---

Mnemonic	Code
PID	---
PWM (@)	---
SCL2 (@)	---
SCL3 (@)	---
SEC (@)	---
SRCH (@)	---
STUP (@)	---
SUM (@)	---
SYNC (@)	---
TIML	---
TMHH	---
ZCP	---
ZCPL	---

SECTION 6
Exchanging Data with CompoBus/S Slaves

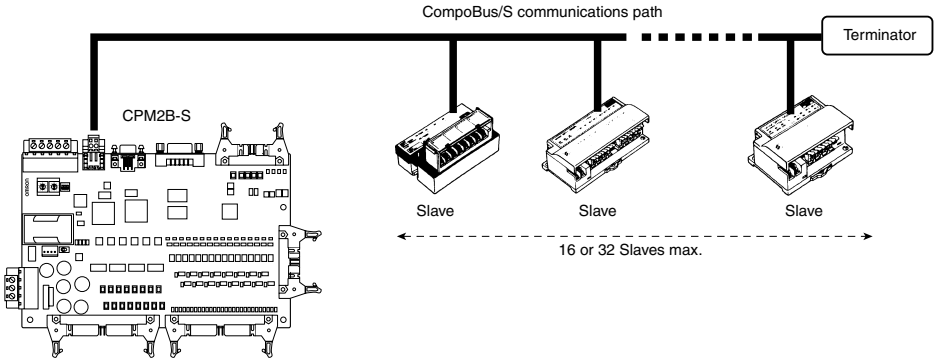
This section explains how to exchange data with CompoBus/S Slaves when using the CPM2B-S as a CompoBus/S Master. Read this section when using CompoBus/S I/O link communications.

6-1 Initial Settings 92
6-1-1 Setting the Maximum Number of Nodes 92
6-1-2 Setting the CompoBus/S Communications Mode 92
6-2 Remote I/O Communications 93
6-2-1 Slaves 93
6-2-2 I/O Allocation 94
6-3 Communications Status 95

6-1 Initial Settings

6-1-1 Setting the Maximum Number of Nodes

The maximum number of Slaves that can be connected through CompoBus/S can be set to 16 or 32 Slaves.



Use a Programming Device to set the maximum number of Slaves in DM 6603 of the PC Setup, as shown in the following table.

Word	Bits	Function		Settings	Default
DM 6603	00 to 03	Sets the max. number of CompoBus/S Slaves to 16 or 32.	0 (Hex): 32 Slaves 1 (Hex): 16 Slaves	0 or 1	0 (32 Slaves)

Note

1. Always turn the power OFF and ON again after changing this setting.
2. The communications response time is affected by the max. number of Slaves setting as shown below.

Communications mode	Max. number of Slaves	Communications response time
High-speed mode	16	0.5 ms
	32	0.8 ms
Long-distance mode	16	4.0 ms
	32	6.0 ms

6-1-2 Setting the CompoBus/S Communications Mode

The CompoBus/S communications mode can be set to high-speed mode or long-distance mode.

Communications mode	Max. communications distance (trunk line length)	Communications speed
High-speed mode	100 m	750 kbps
Long-distance mode	500 m	93.75 kbps

Use a Programming Device to set the maximum number of Slaves in DM 6603 of the PC Setup, as shown in the following table.

Word	Bits	Function		Settings	Default
DM 6603	04 to 07	Sets the CompoBus/S communications mode.	0 (Hex): High-speed mode 1 (Hex): Long-distance mode	0 or 1	0 (High-speed)

Note Always turn the power OFF and ON again after changing this setting.

6-2 Remote I/O Communications

6-2-1 Slaves

The following table lists the commonly used Slaves. Refer to the *CompoBus/S Operation Manual* for more details. The SRT1-series Slaves support high-speed communications mode only. The SRT2-series Slaves support both high-speed and long-distance communications modes.

Name	SRT2-series	SRT1-series
I/O Terminals (Transistor)	SRT2-ID04 SRT2-ID04-1 SRT2-ID08 SRT2-ID08-1 SRT2-ID16 SRT2-ID16-1 SRT2-ID16T SRT2-ID16T-1 SRT2-OD04 SRT2-OD04-1 SRT2-OD08 SRT2-OD08-1 SRT2-OD16 SRT2-OD16-1 SRT2-OD16T SRT2-OD16T-1 SRT2-MD16T SRT2-MD16T-1	SRT1-ID04 SRT1-ID04-1 SRT1-ID08 SRT1-ID08-1 SRT1-ID16 SRT1-ID16-1 Not available Not available SRT1-OD04 SRT1-OD04-1 SRT1-OD08 SRT1-OD08-1 SRT1-OD16 SRT1-OD16-1 Not available Not available Not available Not available
Connector Terminals (Transistor)	SRT2-VID08S SRT2-VID08S-1 SRT2-VID16ML SRT2-VID16ML-1 SRT2-ID32ML SRT2-ID32ML-1 SRT2-VOD08S SRT2-VOD08S-1 SRT2-VOD16ML SRT2-VOD16ML-1 SRT2-OD32ML SRT2-OD32ML-1 SRT2-MD32ML SRT2-MD32ML-1	Not available
Output Terminals (Relay outputs)	SRT2-ROC08 SRT2-ROC16	SRT1-ROC08 SRT1-ROC16
Output Terminals (Power MOSFET outputs)	SRT2-ROF08 SRT2-ROF16	SRT1-ROF08 SRT1-ROF16
I/O Modules	Not available	SRT1-ID16P SRT1-OD16P
Analog Terminals	SRT2-AD04 SRT2-DA02	Not available
Sensor Amplifier Terminals	Not available	SRT1-TID04S SRT1-XID04S
Sensor Terminals	Not available	SRT1-ID08S SRT1-OD08S SRT1-ND08S

Name	SRT2-series	SRT1-series
Bit-chain Terminal	Not available	SRT1-B1T
Environment Resistive Terminals	SRT2-ID04CL SRT2-ID04CL-1 SRT2-ID08 SRT2-ID08CL-1 SRT2-OD04CL SRT2-OD04CL-1 SRT2-OD08CL SRT2-OD08CL-1	Not available

6-2-2 I/O Allocation

In the CPM2B-S, CompoBus/S input words IR 020 to IR 027 and CompoBus/S output words IR 030 to IR 037 are allocated for the CompoBus/S Terminal's I/O. The CompoBus/S Terminal's I/O (IN0 to IN15 and OUT0 to OUT15) are allocated as indicated in the following table.

IN0 to IN15 are the node addresses for the Input Terminals and OUT0 to OUT15 are the node addresses for the Output Terminals.

Word		Relay numbers															
		Bit															
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Input	IR 020	IN1								IN0							
	IR 021	IN3								IN2							
	IR 022	IN5								IN4							
	IR 023	IN7								IN6							
	IR 024	IN9								IN8							
	IR 025	IN11								IN10							
	IR 026	IN13								IN12							
	IR 027	IN15								IN14							
Output	IR 030	OUT1								OUT0							
	IR 031	OUT3								OUT2							
	IR 032	OUT5								OUT4							
	IR 033	OUT7								OUT6							
	IR 034	OUT9								OUT8							
	IR 035	OUT11								OUT10							
	IR 036	OUT13								OUT12							
	IR 037	OUT15								OUT14							

Note

1. When the maximum number of CompoBus/S nodes is set to 16, IN8 to IN15 and OUT8 to OUT15 can be used as work bits.
2. CompoBus/S Terminals with less than 8 points are allocated bit addresses from either 0 or 8, filling up from the lowest available word.
3. CompoBus/S Terminals with 16 points can be set for only even number addresses.

6-3 Communications Status

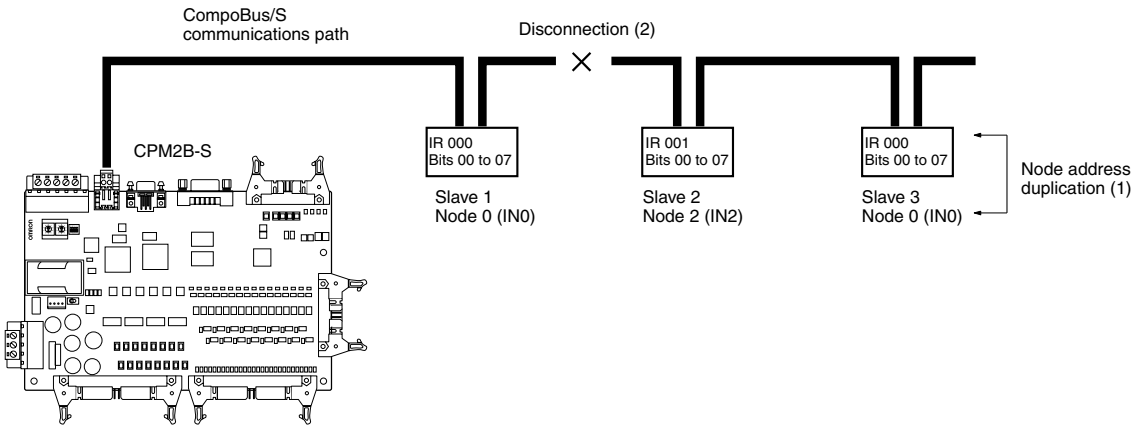
The status of communications with CompoBus/S Terminals is indicated with the status flags in AR 04 through AR 07. Bits 0 to 7 contain the Active Slave Flags and bits 8 to 15 contain the Slave Communications Error Flags.

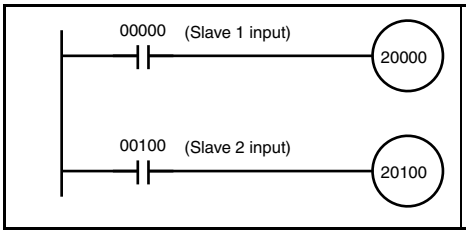
Word	Uppermost bits: Slave Communications Error Flags								Lower Bits: Active Slave Flags							
	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
AR04	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	OUT0	OUT7	OUT6	OUT5	OUT4	OUT3	OUT2	OUT1	OUT0
AR05	IN7	IN6	IN5	IN4	IN3	IN2	IN1	IN0	IN7	IN6	IN5	IN4	IN3	IN2	IN1	IN0
AR06	OUT 15	OUT 14	OUT 13	OUT 12	OUT 11	OUT 10	OUT 9	OUT 8	OUT 15	OUT 14	OUT 13	OUT 12	OUT 11	OUT 10	OUT 9	OUT 8
AR07	IN15	IN14	IN13	IN12	IN11	IN10	IN9	IN8	IN15	IN14	IN13	IN12	IN11	IN10	IN9	IN8

Note

1. IN0 to IN15 are the input terminals and OUT0 to OUT15 are the output terminals.
2. When the maximum number of CompoBus/S units is set to 16, IN8 to IN15 and OUT8 to OUT15 cannot be used.
3. Each Active Slave Flag is turned ON when the corresponding Slave is participating in communications. When the power to the CPU Unit is turned OFF and ON again all of the Active Slave Flags are turned OFF.
4. Each Slave Communications Error Flag is turned ON when a Slave that was participating in the network is separated from the network. The bit is turned OFF when the Slave re-enters the network.
5. An error is not generated at the CPM2B-S if there are duplicated node address settings for Slaves or if there is a communications error, such as communications failure or a disconnection. Therefore, use the above status flags in the ladder program to confirm whether or not node addresses are set correctly, and whether or not Slaves are operating correctly.

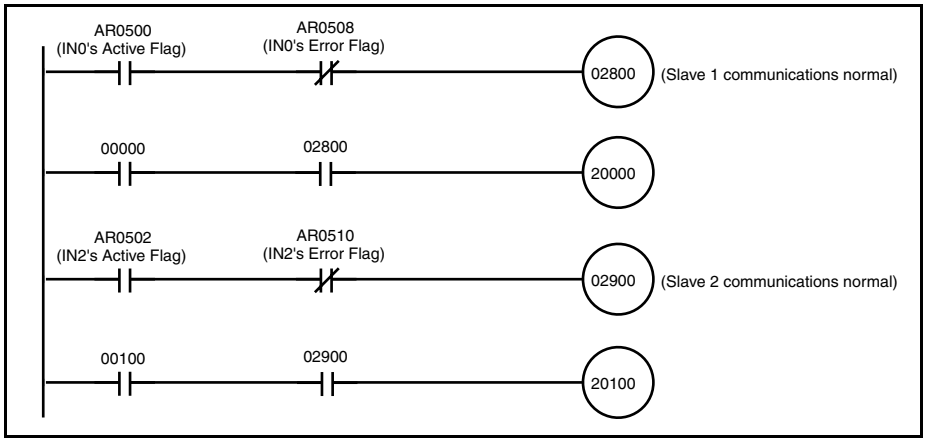
Example





If the addresses for Slave 1 and Slave 3 are the same, the Master will not be able to read input from Slave 3.
If a communications error is generated, the status of IR 00100 will be the same as before the error and so the change in the status of the actual input will not be detected.

• Example of Countermeasure in Ladder Program



SECTION 7
Exchanging Data with a DeviceNet Master

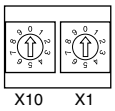
This section explains how data is exchanged between the CPM2B-S100M-DRT and a DeviceNet Master. Refer to this section when using remote I/O communications or explicit message communications from a DeviceNet Master.

7-1 Initial Settings 98
7-1-1 Setting the Node Number 98
7-1-2 Setting the Communications Speed 98
7-1-3 Attaching Status Information 98
7-2 Remote I/O Communications 98
7-3 Explicit Message Communications 101
7-3-1 DeviceNet Explicit Message Functions 101
7-3-2 Command and Response Formats 102
7-3-3 Examples of DeviceNet Explicit Messages 108
7-4 Status Information 113
7-4-1 LED Indicators 113
7-4-2 AR Area Flags indicating DeviceNet Status 114
7-4-3 CPM2B-S Status Output to DeviceNet 114

7-1 Initial Settings

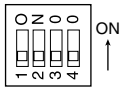
7-1-1 Setting the Node Number

Set the DeviceNet node number with the rotary switches on the CPM2B-S CPU Board. The allowed setting range is 00 to 63; node number settings 64 to 99 are not allowed. The rotary switch settings are read when the Unit's power is turned ON.



7-1-2 Setting the Communications Speed

Set the DeviceNet communications speed with DIP switch 2 on the front of the Unit. The DIP switch settings are read when the Unit's power is turned ON.



DIP switch 2 settings		DeviceNet communications speed	Maximum total communications distance
Pin 1	Pin 2		
OFF	OFF	125 kbps	500 m max.
ON	OFF	250 kbps	250 m max.
OFF	ON	500 kbps	100 m max.
ON	ON	Not used.	---

7-1-3 Attaching Status Information

It is possible to enable and disable the attachment of the CPM2B-S status information in transmissions from the CPM2B-S to the Master Unit.

The status attachment is set in DM 6605 of the PC Setup, as shown in the following table. The initial setting is 0 (attach status information); change this setting to 1 to disable attachment of status information. Refer to *7-4 Status Information* for details on the status information.

Word	Bits	Function	Default
DM 6605	04 to 07	Sets whether CPM2B-S status is transmitted to the DeviceNet Master. 0 (Hex): Attach status ahead of data. 1 (Hex): Do not attach status ahead of data.	0 (Attach status.)

7-2 Remote I/O Communications

Allocate the DeviceNet read and write areas to specify what part of the PC's data area will be used to read and write data from the DeviceNet Master Unit. Specify the PC data area, starting word address, and number of bytes. Up to 64 bytes can be allocated for DeviceNet remote I/O.

Allocating Read/Write Areas with the PC Setup

Switch the CPM2B-S to PROGRAM mode and use a Programming Device, such as a Programming Console or Support Software, to make the following settings in DM 6605 to DM 6609 of the PC Setup. The settings in these words are read only when the CPM2B-S is turned ON, so the PC's power must be turned OFF and then ON again to make changes effective.

Word	Bits	Function		Default
DM 6605	00 to 03	DeviceNet Read/Write area setting 0 (Hex): Read (IN) IR 020 to IR 027; Write (OUT) IR 030 to IR 037 1 (Hex): Use settings in DM 6606 to DM 6609.		0 (Hex)
	04 to 07	Transmission of CPM2B-S status to the DeviceNet Master 0 (Hex): Attach status information ahead of data. 1 (Hex): Do not attach status information ahead of data.		0 (Hex)
	08 to 15	Not used.		0 (Hex)
DM 6606	00 to 07	DeviceNet I/O Link Write (OUT) area settings (Master → CPM2B-S)	Data area 01 (Hex): I/O area 1 (IR 000 to IR 049) 02 (Hex): I/O area 2 (IR 200 to IR 227) 03 (Hex): DM area (DM 0000 to DM 2047) 04 (Hex): LR area (LR 00 to LR 15) 05 (Hex): HR area (HR 00 to HR 19) 07 (Hex): Timer/counter area (TC 000 to TC 255)	00 (Hex)
	08 to 15		Number of bytes (see note 1) 01 to 40 (Hex) (equivalent to 0 to 64 decimal)	00 (Hex)
DM 6607	00 to 15		Starting word address 0000 to 07FF (Hex) (equivalent to 0000 to 2047 decimal)	0000 (Hex)
DM 6608	00 to 07	DeviceNet I/O Link Read (IN) area settings (CPM2B-S → Master)	Data area 01 (Hex): I/O area 1 (IR 000 to IR 049) 02 (Hex): I/O area 2 (IR 200 to IR 227) 03 (Hex): DM area (DM 0000 to DM 2047) 04 (Hex): LR area (LR 00 to LR 15) 05 (Hex): HR area (HR 00 to HR 19) 06 (Hex): AR area (AR 00 to AR 23) 07 (Hex): Timer/counter area (TC 000 to TC 255)	00 (Hex)
	08 to 15		Number of bytes (see note 1) 01 to 40 (Hex) (equivalent to 0 to 64 decimal)	00 (Hex)
DM 6609	00 to 15		Starting word address 0000 to 07FF (Hex) (equivalent to 0000 to 2047 decimal)	0000 (Hex)

Note

1. A system failure error (PC Setup setting error) will occur if the number of bytes is set to 00 (Hex) for both the write and read areas.
2. Data written through DeviceNet is valid even if the PC is in PROGRAM mode, so outputs may go ON when the PC is in PROGRAM mode if output bits are allocated to the DeviceNet I/O Link Write area. To prevent outputs from going ON while the PC is in PROGRAM mode, do not allocate output bits directly to the DeviceNet I/O Link Write area.
3. If words in any areas other than the IR area (IR 000 to IR 227) or LR area (LR 00 to LR 15) are allocated to the I/O Link Read area, the data may not be cleared even when the power is interrupted, possibly causing data from immediately before power interruption to be read by the master. If this creates a potential problem, use the following measures to eliminate the problem.
   - When starting in RUN or MONITOR mode, configure the ladder program so that the Read area is rewritten with appropriate data.
   - When starting in PROGRAM mode, it will not be possible to take direct measures at the slave. Monitor the status at the master and do not read the data when the operating mode is PROGRAM mode.

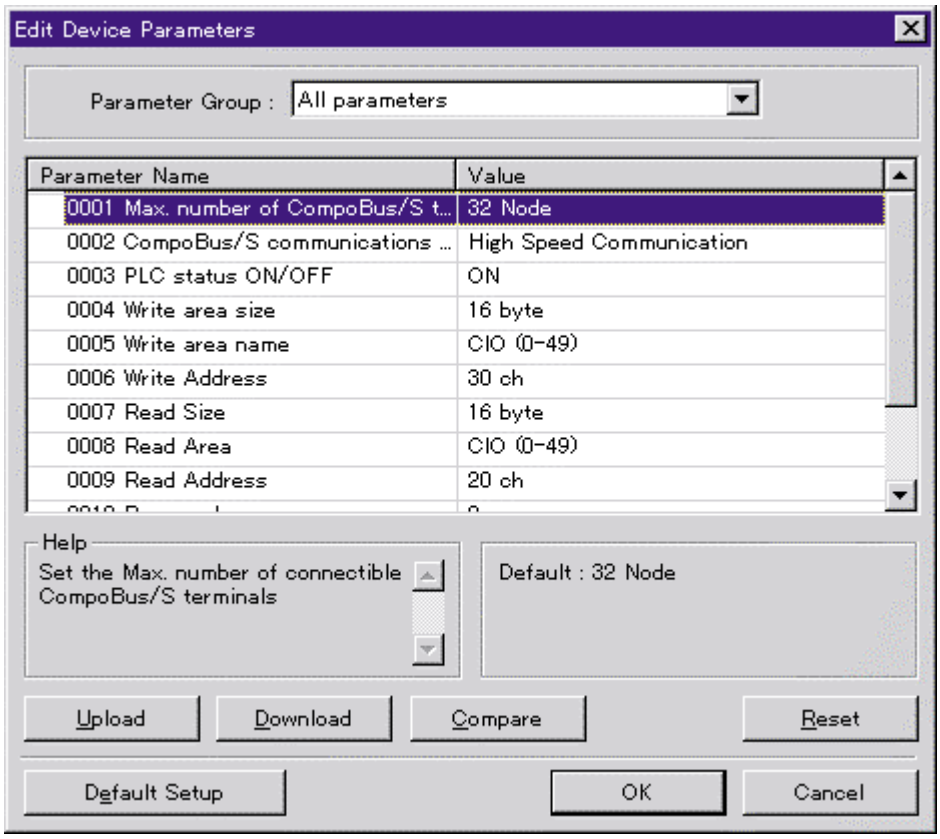
   When a fatal error occurs at a slave, the master may read data from immediately before the error. In this case also, monitor the status at the master and do not read the data.

Allocating Read/Write Areas with the DeviceNet Configurator

An OMRON DeviceNet Configurator (version 2.0 or higher) can be used to specify the DeviceNet Read and Write areas. Contact your OMRON representative if you are using a Configurator version earlier than 2.0. (The version can be displayed in the Configurator's *Help* menu.)

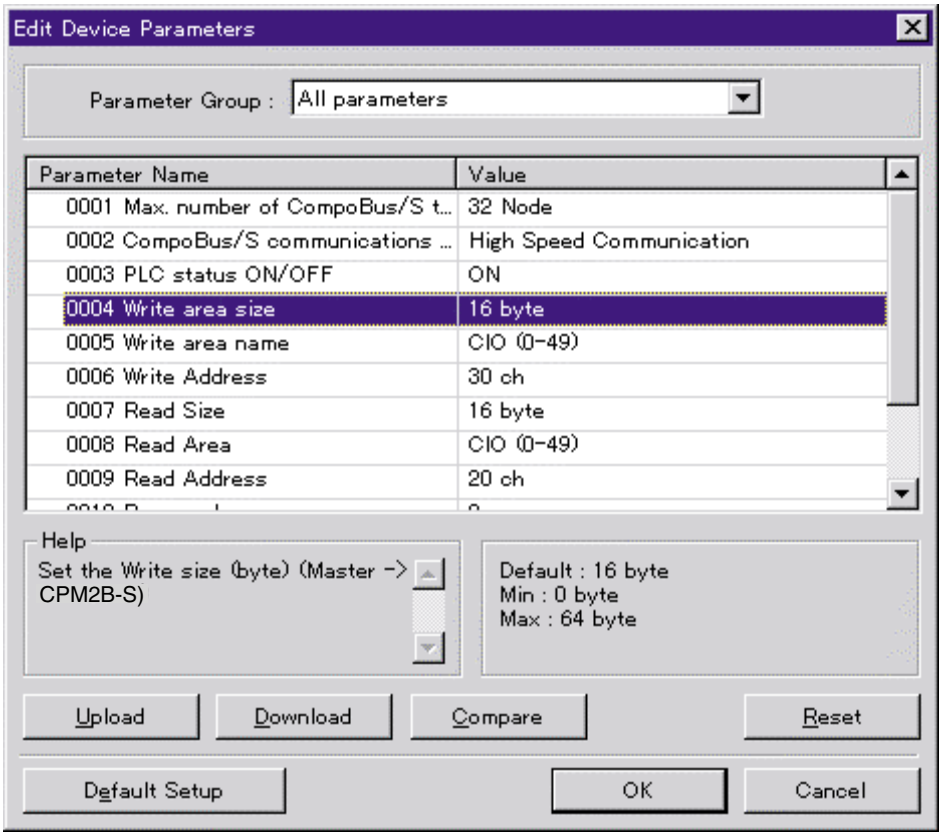
1,2,3...

1. Connect the DeviceNet Configurator to the DeviceNet network and switch to online operation.
2. Turn ON the CPM2B-S power supply and put the PC in PROGRAM mode.
3. Click the Upload Button.
4. Double-click the CPM2B-S to be set on the DeviceNet Configurator's device list.
5. The DeviceNet Parameters Window will be displayed to edit the read and write area parameters. Double-click the read/write area parameters to be changed.



6. Change the parameters as shown in the following example.

a) Double-click the parameter to be changed.



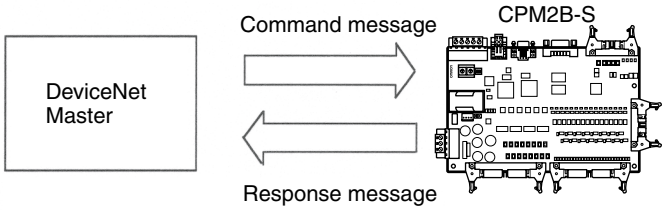
b) Enter the desired value and press the Enter Key.

7. When all parameters are set as required, click the Download Button.
8. After the download has been completed, click the OK Button to return to the list display.

7-3 Explicit Message Communications

7-3-1 DeviceNet Explicit Message Functions

Explicit message communications use a command/response protocol. The CPM2B-S returns responses to commands sent from the Master, allowing CPM2B-S data areas to be read or written from the Master.



Explicit Message List

Explicit message	Function	Page
READ BYTE DATA	Reads the specified node's data in byte-units from the DeviceNet Master. When word data is being read, the leftmost byte is read before the rightmost byte. Up to 200 bytes can be read at one time.	102
WRITE BYTE DATA	Writes data from the DeviceNet Master to the specified node's data area in byte-units. When word data is being written, the leftmost byte is written before the rightmost byte. Up to 200 bytes can be written at one time.	104
READ WORD DATA	Reads the specified node's data in word-units (two-byte units) from the DeviceNet Master. When word data is being read, the leftmost byte is read before the rightmost byte. Up to 100 words can be read at one time.	105
WRITE WORD DATA	Writes data from the DeviceNet Master to the specified node's data area in word-units (two-byte units). When word data is being written, the leftmost byte is written before the rightmost byte. Up to 100 words can be written at one time.	106
ERROR RESPONSE	The CPM2B-S returns an error response when there is an error in the explicit message command sent from the DeviceNet Master.	108

Note

1. When sending explicit message commands, the range of data specified by the data area, starting address, and number of bytes must not exceed the range of the CPM2B-S data area.
2. Use the READ BYTE DATA and WRITE BYTE DATA commands when sending explicit message commands from an OMRON DeviceNet Master.

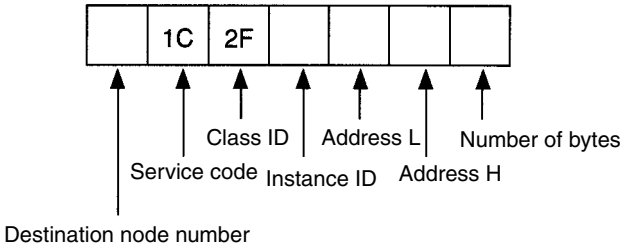
   Use the READ WORD DATA and WRITE WORD DATA commands when sending explicit message commands from another company's DeviceNet Master.
3. The number of bytes occupied by the "Class ID" and "Instance ID" parameters varies from Master to Master. These parameters are specified in 2 bytes (4 digits) in commands sent from OMRON DeviceNet Masters. (CV-series PCs use the CMND instruction and C200HX/HG/HE PCs use the IOWR instruction.)

7-3-2 Command and Response Formats

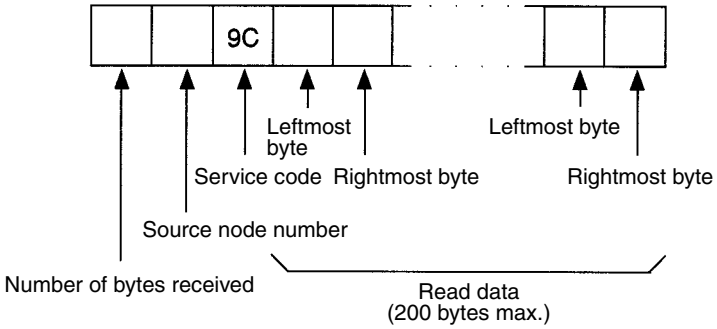
READ BYTE DATA

Reads the specified node's data in byte-units from the DeviceNet Master. When word data is being read, the leftmost byte is read before the rightmost byte. Up to 200 bytes can be read at one time.

Command Format



Response Format



Parameters

Destination node number (command)
Specify the node number of the CPM2B-S containing the desired data in 1 byte (2-digit hexadecimal).

Service code (command, response)
Specify 1C (Hex) in the command.
The leftmost bit of the service code is turned ON in the response, so 9C (Hex) is returned.

Class ID (command)
Always 2F (Hex).

Instance ID (command)
Specify the data area containing the desired data in 1 byte (2-digit hexadecimal). Use one of the codes listed in the following table.

Code	Area name	Address range
01 (Hex)	IR area	IR 000 to IR 049
02 (Hex)	IR area	IR 200 to IR 227
03 (Hex)	DM area	DM 0000 to DM 2047
04 (Hex)	LR area	LR 00 to LR 15
05 (Hex)	HR area	HR 00 to HR 19
06 (Hex)	AR area	AR 00 to AR 23 (read area only)
07 (Hex)	Timer/Counter area	TC 000 to TC 255

Address L and Address H (command)
Specify the starting word address of the read data in hexadecimal as follows:

Address L: The rightmost two digits of the 4-digit starting address.
Address H: The leftmost two digits of the 4-digit starting address.

Number of bytes (command)
Specify the number of bytes of data to read in 1 byte (2-digit hexadecimal). The allowed range is 01 to C8 (Hex), which is equivalent to 1 to 200 decimal.

Number of bytes received (response)
Indicates the number of bytes of data (in hexadecimal) from the “source node number” on.

Source node number (response)
Indicates the node number (in hexadecimal) of the CPM2B-S that returned the response.

Read data (response)
Contains the desired data read from the specified data area. Word data is returned with the leftmost byte (bits 8 to 15) preceding the rightmost byte (bits 0 to 7). If an odd number was specified in the command’s “number of bytes” parameter, the last byte of read data will contain the leftmost byte of a word.

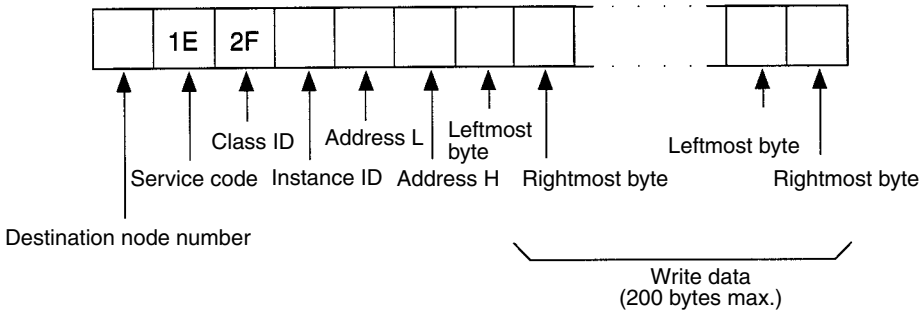
Precautions

The range of data specified by the data area (instance ID), starting address (Address L and Address H), and number of bytes parameters must not exceed the range of the CPM2B-S data area.

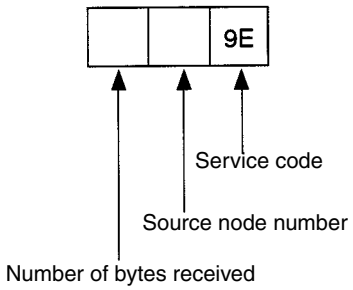
WRITE BYTE DATA

Writes data from the DeviceNet Master to the specified node's data area in byte-units. When word data is being written, the leftmost byte is written before the rightmost byte. Up to 200 bytes can be written at one time.

Command Format



Response Format



Parameters

Destination node number (command)

Specify the node number of the CPM2B-S where the data will be written. Specify the node number in 1 byte (2-digit hexadecimal).

Service code (command, response)

Specify 1E (Hex) in the command.

The leftmost bit of the service code is turned ON in the response, so 9E (Hex) is returned.

Class ID (command)

Always 2F (Hex).

Instance ID (command)

Specify the data area where data will be written. Specify one of the codes listed in the following table in 1 byte (2-digit hexadecimal).

Code	Area name	Address range
01 (Hex)	IR area	IR 000 to IR 049
02 (Hex)	IR area	IR 200 to IR 227
03 (Hex)	DM area	DM 0000 to DM 2047
04 (Hex)	LR area	LR 00 to LR 15
05 (Hex)	HR area	HR 00 to HR 19
07 (Hex)	Timer/Counter area	TC 000 to TC 255

Address L and Address H (command)

Specify the starting word address where data will be written. Specify the address in hexadecimal as follows:

Address L: The rightmost two digits of the 4-digit starting address.
Address H: The leftmost two digits of the 4-digit starting address.

Write data (command)
Contains the data that will be written in the specified data area. Input word data with the leftmost byte (bits 8 to 15) preceding the rightmost byte (bits 0 to 7). If the command contains an odd number of bytes of write data, the last byte will be written to the leftmost byte of the last word.

Number of bytes received (response)
Indicates the number of bytes of data (in hexadecimal) from the "source node number" on.

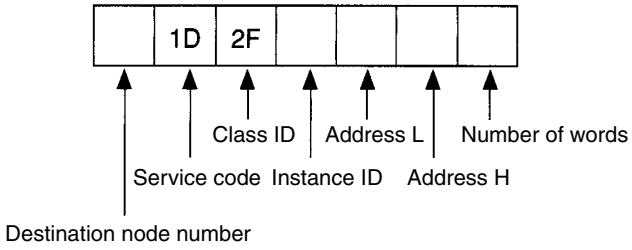
Source node number (response)
Indicates the node number (in hexadecimal) of the CPM2B-S that returned the response.

Precautions
The range of data specified by the data area (instance ID), starting address (Address L and Address H), and write data parameters must not exceed the range of the CPM2B-S data area.

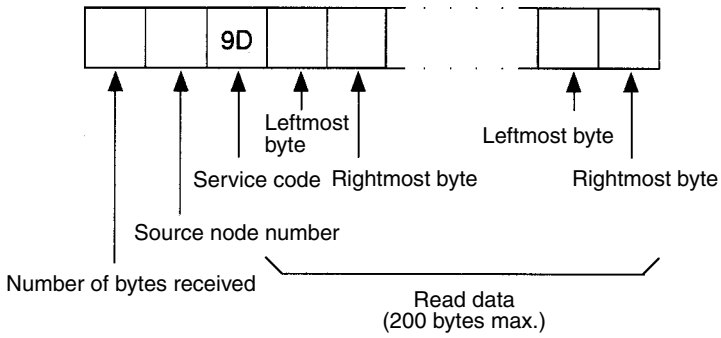
READ WORD DATA

Reads the specified node's data in word-units (two-byte units) from the DeviceNet Master. When word data is being read, the leftmost byte is read before the rightmost byte. Up to 100 words can be read at one time.

Command Format



Response Format



Parameters

Destination node number (command)
Specify the node number of the CPM2B-S containing the desired data in 1 byte (2-digit hexadecimal).

Service code (command, response)
Specify 1D (Hex) in the command.
The leftmost bit of the service code is turned ON in the response, so 9D (Hex) is returned.

Class ID (command)
Always 2F (Hex).

Instance ID (command)
Specify the data area containing the desired data in 1 byte (2-digit hexadecimal). Use one of the codes listed in the following table.

Code	Area name	Address range
01 (Hex)	IR area	IR 000 to IR 049
02 (Hex)	IR area	IR 200 to IR 227
03 (Hex)	DM area	DM 0000 to DM 2047
04 (Hex)	LR area	LR 00 to LR 15
05 (Hex)	HR area	HR 00 to HR 19
06 (Hex)	AR area	AR 00 to AR 23 (read area only)
07 (Hex)	Timer/Counter area	TC 000 to TC 255

Address L and Address H (command)
Specify the starting word address of the read data in hexadecimal as follows:

Address L: The rightmost two digits of the 4-digit starting address.
Address H: The leftmost two digits of the 4-digit starting address.

Number of words (command)
Specify the number of words of data to read in 1 byte (2-digit hexadecimal). The allowed range is 01 to 64 (Hex), which is equivalent to 1 to 100 decimal.

Number of bytes received (response)
Indicates the number of bytes of data (in hexadecimal) from the "source node number."

Source node number (response)
Indicates the node number (in hexadecimal) of the CPM2B-S that returned the response.

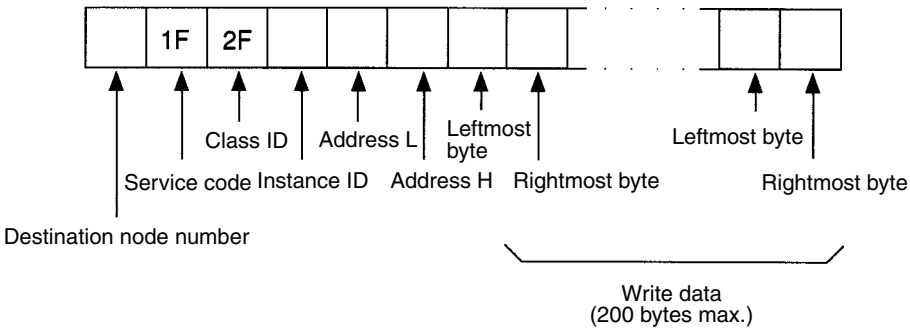
Read data (response)
Contains the desired data read from the specified data area. Word data is returned with the leftmost byte (bits 8 to 15) preceding the rightmost byte (bits 0 to 7).

Precautions
The range of data specified by the data area (instance ID), starting address (Address L and Address H), and number of words parameters must not exceed the range of the CPM2B-S data area.

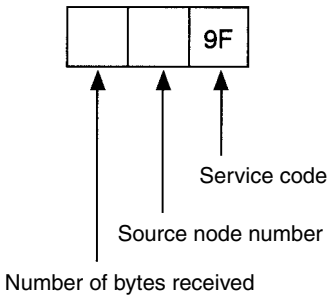
WRITE WORD DATA

Writes data from the DeviceNet Master to the specified node's data area in word-units (two-byte units). When word data is being written, the leftmost byte is written before the rightmost byte. Up to 100 words can be written at one time.

Command Format



Response Format



Parameters

Destination node number (command)
Specify the node number of the CPM2B-S where the data will be written. Specify the node number in 1 byte (2-digit hexadecimal).

Service code (command, response)
Specify 1F (Hex) in the command.
The leftmost bit of the service code is turned ON in the response, so 9F (Hex) is returned.

Class ID (command)
Always 2F (Hex).

Instance ID (command)
Specify the data area where data will be written. Specify one of the codes listed in the following table in 1 byte (2-digit hexadecimal).

Code	Area name	Address range
01 (Hex)	IR area	IR 000 to IR 049
02 (Hex)	IR area	IR 200 to IR 227
03 (Hex)	DM area	DM 0000 to DM 2047
04 (Hex)	LR area	LR 00 to LR 15
05 (Hex)	HR area	HR 00 to HR 19
07 (Hex)	Timer/Counter area	TC 000 to TC 255

Address L and Address H (command)
Specify the starting word address where data will be written. Specify the address in hexadecimal as follows:

Address L: The rightmost two digits of the 4-digit starting address.
Address H: The leftmost two digits of the 4-digit starting address.

Write data (command)
Contains the data that will be written in the specified data area. Input word data with the leftmost byte (bits 8 to 15) preceding the rightmost byte (bits 0 to 7).

Number of bytes received (response)
Indicates the number of bytes of data (in hexadecimal) from the “source node number” on.

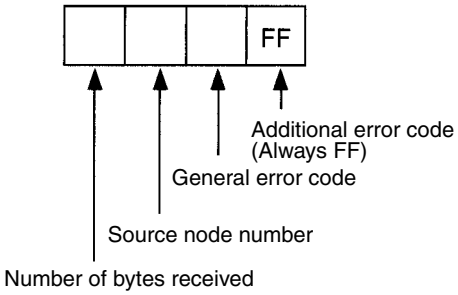
Source node number (response)
Indicates the node number (in hexadecimal) of the CPM2B-S that returned the response.

Precautions
The range of data specified by the data area (instance ID), starting address (Address L and Address H), and write data parameters must not exceed the range of the CPM2B-S data area.

ERROR RESPONSE

The CPM2B-S returns an error response when there is an error in the explicit message command sent from the DeviceNet Master.

Response Format



Parameters

Number of bytes received (response)
Indicates the number of bytes of data (in hexadecimal) from the "source node number."

Source node number (response)
Indicates the node number (in hexadecimal) of the CPM2B-S that returned the response.

General error code (response)
Indicates the nature of the error with one of the 1-byte (2-digit hexadecimal) error codes listed in the following table.

Code	Error name	Meaning
08 (Hex)	Service not supported	The service code was invalid.
15 (Hex)	Too much data	There was too much data. (For example, the amount of write data exceeded the data area boundary.)
13 (Hex)	Not enough data	There was too little data. (For example, an odd number of bytes of write data were used in a WRITE WORD DATA command.)
20 (Hex)	Invalid parameter	The starting word address was invalid.
11 (Hex)	Reply data too large	The data area boundary was exceeded in a DATA READ command.
16 (Hex)	Object does not exist	The class ID or instance ID was invalid.

Additional error code (response)

Always FF (Hex).

7-3-3 Examples of DeviceNet Explicit Messages

CS1, CVM1, and CV-series PCs: Reading Data with CMND(194)

This example shows the instruction operands and results when 20 words of data (IR 010 to IR029) in a Slave are read through a Master mounted in a CS1, CVM1 or CV-series PC.

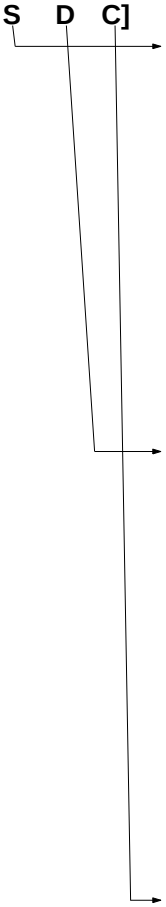
For details on explicit messages, refer to the *CS1 Series DeviceNet Unit Operation Manual* (W380) for CS1-series PCs, and refer to the *DeviceNet (CompoBus/D) Operation Manual* (W267) for CVM1 and CV-series PCs. For details on CMND(194), refer to the *CS1 Series Programmable Controllers Operation Manual* (W339) for CS1-series PCs, and refer to the *CVM1/CV Series CV500/CV100/CV2000/CVM1 Programmable Controllers Operation Manual: Ladder Diagrams* (W202) for CVM1 and CV-series PCs.

Example Network Conditions

Master's node number: 63
Slave's network address: 1
Slave's node number: 2

CMND(194) Operand Details

[CMND S D C]



- Command Words

Word	Contents (Hex)	Function
S	28 01	EXPLICIT MESSAGE SEND command code = 2801 (Hex)
S+1	02 1C	Slave node number = 02 (Hex) READ BYTE DATA command service code = 1C (Hex)
S+2	00 2F	Class ID = 002F (Hex)
S+3	00 01	Instance ID = 0001 (Hex) specifies data area
S+4	0A 00	Starting read address = 000A (Hex) specifies IR 010 Address L = 0A (Hex); Address H = 00 (Hex)
S+5	28 00	Number of bytes = 28 (Hex) specifies 40 bytes (The rightmost byte of S+5 is not used.)

- Response Words
  (The results are stored as follows.)

Word	Contents (Hex)	Function
D	28 01	EXPLICIT MESSAGE SEND command code = 2801 (Hex)
D+1	00 00	Normal completion code = 0000 (Hex)
D+2	00 2A	Number of bytes received = 2A (Hex) indicates 42 bytes (This is the number of bytes from D+3 to the end.)
D+3	02 9C	Slave's node number = 02 (Hex) READ BYTE DATA response service code = 9C (Hex)
D+4 to D+23	HH LL : HH LL	These words contain the data read from slave words IR 010 to IR 029. When the READ BYTE DATA command is executed from an OMRON Master, the bytes are stored in the same order (HH LL) in which they were stored in the Slave.

- Control Words

Word	Contents (Hex)	Function
C	00 0B	Number of bytes of command data beginning with word S = 0B (Hex) specifies 11 bytes
C+1	00 30	Number of bytes of response data beginning with word D = 30 (Hex) specifies 48 bytes
C+2	00 01	Destination network address = 01 (Hex)
C+3	3F FE	Master's node number = 3F (Hex) specifies 63 Master's unit address = FE (Hex) specifies the local Unit
C+4	00 00	Response required Transmission port number = 00 (Hex) specifies 0 Number of retries = 00 (Hex) specifies 0
C+5	00 64	Response monitoring time = 64 (Hex) specifies 10.0 seconds

CS1, CVM1, and CV-series PCs: Writing Data with CMND(194)

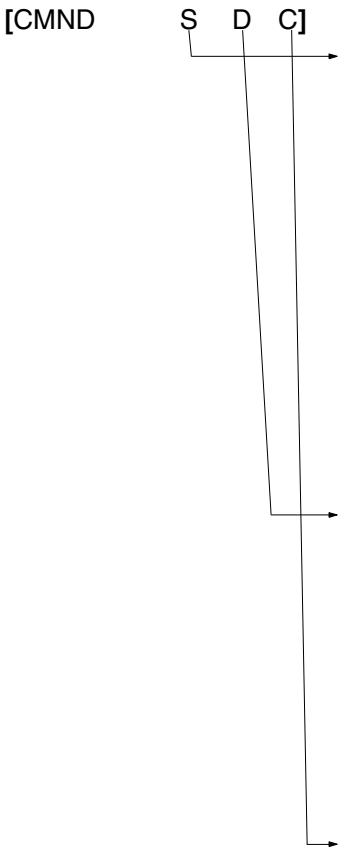
This example shows the instruction operands and results when 20 words of data are written through a Master mounted in a CS1, CVM1, or CV-series PC to words IR 010 to IR 029 in a Slave.

For details on explicit messages, refer to the *CS1 Series DeviceNet Unit Operation Manual* (W380) for CS1-series PCs, and refer to the *DeviceNet (CompoBus/D) Operation Manual* (W267) for CVM1 and CV-series PCs. For details on CMND(194), refer to the *CS1 Series Programmable Controllers Operation Manual* (W339) for CS1-series PCs, and refer to the *CVM1/CV Series CV500/CV100/CV2000/CVM1 Programmable Controllers Operation Manual: Ladder Diagrams* (W202) for CVM1 and CV-series PCs.

Example Network Conditions

Master's node number: 63
Slave's network address: 1
Slave's node number: 2

CMND(194) Operand Details



• Command Words

Word	Contents (Hex)	Function
S	28 01	EXPLICIT MESSAGE SEND command code = 2801 (Hex)
S+1	02 1C	Slave node number = 02 (Hex) WRITE BYTE DATA command service code = 1E (Hex)
S+2	00 2F	Class ID = 002F (Hex)
S+3	00 01	Instance ID = 0001 (Hex) specifies data area
S+4	0A 00	Starting write address = 000A (Hex) specifies IR 010 Address L = 0A (Hex); Address H = 00 (Hex)
S+5 to S+24	HH LL : HH LL	These words contain the data to be written to slave words IR 010 to IR 029. When the WRITE BYTE DATA command is executed from an OMRON Master, the bytes are written to the Slave in the same order (HH LL) in which they appear in the Master.

• Response Words
(The results are stored as follows.)

Word	Contents (Hex)	Function
D	28 01	EXPLICIT MESSAGE SEND command code = 2801 (Hex)
D+1	00 00	Normal completion code = 0000 (Hex)
D+2	00 02	Number of bytes received = 02 (Hex) indicates 2 bytes (This is the number of bytes from D+3 to the end.)
D+3	02 9C	Slave's node number = 02 (Hex) WRITE BYTE DATA response service code = 9E (Hex)

• Control Words

Word	Contents (Hex)	Function
C	00 32	Number of bytes of command data beginning with word S = 32 (Hex) specifies 50 bytes
C+1	00 08	Number of bytes of response data beginning with word D = 08 (Hex) specifies 8 bytes
C+2	00 01	Destination network address = 01 (Hex)
C+3	3F FE	Master's node number = 3F (Hex) specifies 63 Master's unit address = FE (Hex) specifies the local Unit
C+4	00 00	Response required Transmission port number = 00 (Hex) specifies 0 Number of retries = 00 (Hex) specifies 0
C+5	00 64	Response monitoring time = 64 (Hex) specifies 10.0 seconds

C200HX/HG/HE PCs: Reading Data with IOWR(– –)

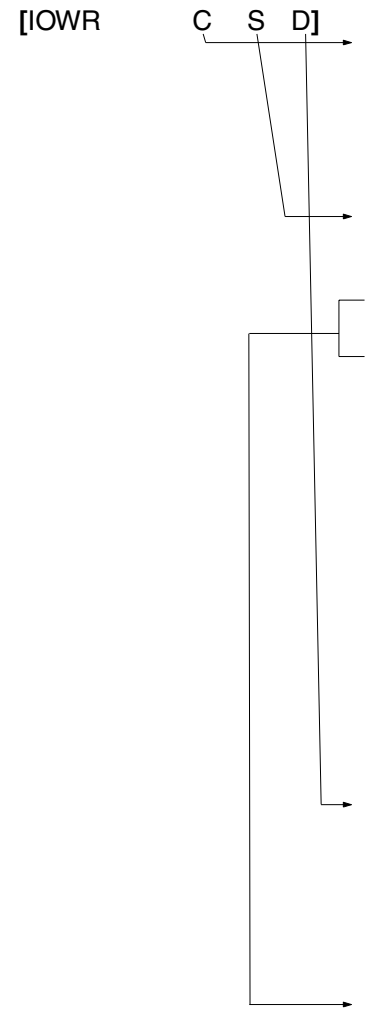
This example shows the instruction operands and results when 20 words of data (IR 010 to IR029) in a Slave are read through a Master mounted in a C200HX/HG/HE PC and stored in words DM 2000 to DM 2019.

Refer to the *DeviceNet (CompoBus/D) Masters Operation Manual* for details on explicit messages and refer to the *C200HX/HG/HE Programmable Controllers Operation Manual* for details on IOWR(– –).

Example Network Conditions

The Master's node number is 63, the Slave's network address is 0, and the Slave's node number is 2.

IOWR(– –) Operand Details



• Control Code

Word	Contents (Hex)	Function
C	3F FE	Master's node number = 3F (Hex) specifies 63 Master's unit address = FE (Hex) specifies the local Unit

• Command Words (Source information)

Word	Contents (Hex)	Function
S	82 07	Specifies starting response word = DM 2000 82 (Hex) specifies the DM area 07D0 (Hex) specifies address 2000 (Refer to the *C200HX/HG/HE Operation Manual* for details.)
S+1	D0 00	
S+2	00 64	Response monitoring time = 64 (Hex) specifies 10.0 seconds
S+3	00 0B	Number of bytes of command data beginning with word S+4 = 0B (Hex) specifies 11 bytes
S+4	28 01	EXPLICIT MESSAGE SEND command code = 2801 (Hex)
S+5	02 1C	Slave node number = 02 (Hex) READ BYTE DATA command service code = 1C (Hex)
S+6	00 2F	Class ID = 002F (Hex)
S+7	00 01	Instance ID = 0001 (Hex) specifies data area
S+8	0A 00	Starting read address = 000A (Hex) specifies IR 010 Address L = 0A (Hex); Address H = 00 (Hex)
S+9	28 00	Number of bytes = 28 (Hex) specifies 40 bytes (The rightmost byte of S+5 is not used.)

• Destination Information

Word	Contents (Hex)	Function
D	00 10	Master Unit's unit number = 00 Number of words of command data beginning with word S = 10 (BCD) specifies 10 words

• Response Words (The results are stored as follows.)

Word	Contents (Hex)	Function
DM 2000	28 01	EXPLICIT MESSAGE SEND command code = 2801 (Hex)
DM 2001	00 00	Normal completion code = 0000 (Hex)
DM 2002	00 2A	Number of bytes received = 2A (Hex) indicates 42 bytes (This is the number of bytes from D+3 to the end.)
DM 2003	02 9C	Slave's node number = 02 (Hex) READ BYTE DATA response service code = 9C (Hex)
DM 2004 to DM 2023	HH LL : HH LL	These words contain the data read from slave words IR 010 to IR 029. When the READ BYTE DATA command is executed from an OMRON Master, the bytes are stored in the same order (HH LL) in which they were stored in the Slave.

C200HX/HG/HE PCs: Writing Data with IOWR(– –)

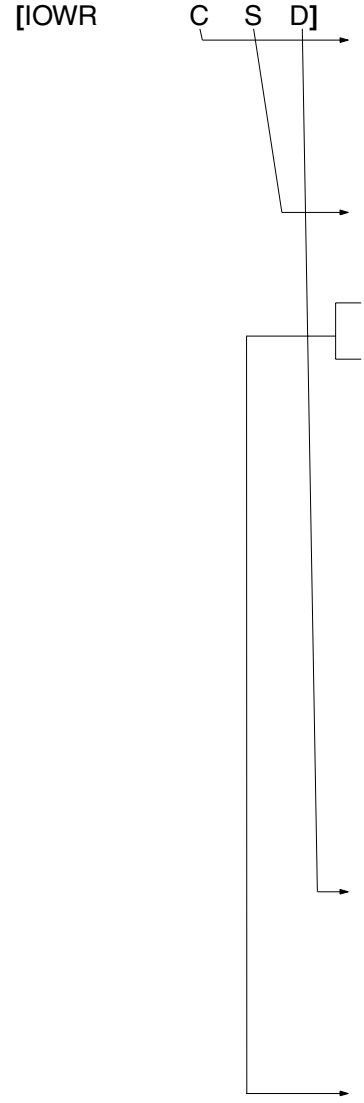
This example shows the instruction operands and results when 20 words of data are written from a Master mounted in a C200HX/HG/HE PC to words IR 010 to IR029 in a Slave.

Refer to the *DeviceNet (CompoBus/D) Masters Operation Manual* for details on explicit messages and refer to the *C200HX/HG/HE Programmable Controllers Operation Manual* for details on IOWR(– –).

Example Network Conditions

Master's node number: 63
Slave's network address: 0
Slave's node number: 2

IOWR(– –) Operand Details



• Control Code

Word	Contents (Hex)	Function
C	3F FE	Master's node number = 3F (Hex) specifies 63 Master's unit address = FE (Hex) specifies the local Unit

• Command Words (Source Information)

Word	Contents (Hex)	Function
S	82 07	Specifies starting response word = DM 2000
S+1	D0 00	82 (Hex) specifies the DM area 07D0 (Hex) specifies address 2000 (Refer to the *C200HX/HG/HE Operation Manual* for details.)
S+2	00 64	Response monitoring time = 64 (Hex) specifies 10.0 seconds
S+3	00 0B	Number of bytes of command data beginning with word S+4 = 32 (Hex) specifies 50 bytes
S+4	28 01	EXPLICIT MESSAGE SEND command code = 2801 (Hex)
S+5	02 1E	Slave node number = 02 (Hex) WRITE BYTE DATA command service code = 1E (Hex)
S+6	00 2F	Class ID = 002F (Hex)
S+7	00 01	Instance ID = 0001 (Hex) specifies data area
S+8	0A 00	Starting write address = 000A (Hex) specifies IR 010 Address L = 0A (Hex); Address H = 00 (Hex)
S+9 to S+28	HH LL : HH LL	These words contain the data to be written to slave words IR 010 to IR 029. When the WRITE BYTE DATA command is executed from an OMRON Master, the bytes are written to the Slave in the same order (HH LL) in which they appear in the Master.

• Destination Information

Word	Contents (Hex)	Function
D	00 29	Master Unit's unit number = 00 Number of words of command data beginning with word S = 29 (BCD) specifies 29 words

• Response Words (The results are stored as follows.)

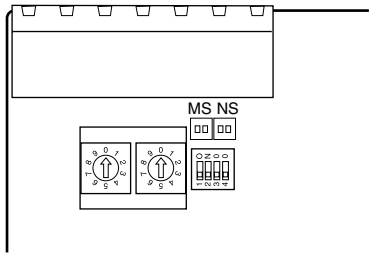
Word	Contents (Hex)	Function
DM 2000	28 01	EXPLICIT MESSAGE SEND command code = 2801 (Hex)
DM 2001	00 00	Normal completion code = 0000 (Hex)
DM 2002	00 02	Number of bytes received = 02 (Hex) indicates 2 bytes (This is the number of bytes from D+3 to the end.)
DM 2003	02 9E	Slave's node number = 02 (Hex) READ BYTE DATA response service code = 9E (Hex)

7-4 Status Information

The status of DeviceNet communications is indicated by the CPM2B-S PC's LED indicators and AR area flags. In addition, the PC Setup can be set so that the CPM2B-S PC's operating status information is attached to remote I/O transmissions from the CPM2B-S to the Master Unit.

7-4-1 LED Indicators

The status of DeviceNet communications is indicated on the CPM2B-S PC's LED indicators.



Indicator	Color	Status	Function	Meaning
MS	Green	Lit	Normal status	Normal status
		Flashing	Incomplete settings status	Reading switch settings
	Red	Lit	Fatal error	Hardware error (watchdog timer error)
		Flashing	Non-fatal error	Error such as incorrect switch settings
	---	Not lit	Power is not being supplied.	• Power is not being supplied. • Waiting for initialization to start • Reset in progress
NS	Green	Lit	Online/Communications established	Normal network status when communications have been established
		Flashing	Online/Communications not established	Normal network status when communications haven't been established
	Red	Lit	Fatal communications error	Communications error (The Unit detected an error indicating that network communications are disabled.) • Node number duplication • Bus off error detected
		Flashing	Non-fatal communications error	Communications timeout
	---	Not lit	Offline/Power supply OFF	Waiting for completion of the node number duplication check in the Master. • Incorrect switch settings • Power supply OFF

7-4-2 AR Area Flags indicating DeviceNet Status

The following status information is output to flags in the AR area.

Word	Bit(s)	Function	
AR 00	00	DeviceNet switch settings error (ON when a settings error occurred, OFF when normal.)	
	01	Node number duplication or Bus off error (ON when an error occurred, OFF when normal.)	
	02	DeviceNet network power supply error (ON when an error occurred, OFF when normal.)	
	03	DeviceNet communications error (ON when an error occurred, OFF when normal.)	
	04 to 06	Not used.	
	07	DeviceNet status error (ON when an error occurred, OFF when normal.)	
	08	Explicit Connection Flag	ON: The connection has been established. OFF: The connection has not been established.
	09	Polling Connection Flag	
	10	Bit Strobe Connection Flag	
	11 to 14	Not used.	
	15	I/O Link in progress (ON when the I/O Link is operating, otherwise OFF.)	

7-4-3 CPM2B-S Status Output to DeviceNet

The operating status of the CPM2B-S is transmitted to the Master Unit in two words. The status information is automatically attached as the first two words received at the Master.

The setting in DM 6605 bits 04 to 07 of the PC Setup determines whether or not the status information will be transmitted.

Word	Bits	Function	Default
DM 6605	04 to 07	Sets whether CPM2B-S status is transmitted to the DeviceNet Master. 0 (Hex): Attach status ahead of data. 1 (Hex): Do not attach status ahead of data. (A settings error will occur for any other setting.)	0 (Attach status.)

Transmitted Status Information

<table>
<tr><th>Word</th><th>Bits</th><th>Contents</th></tr>
<tr><td rowspan="6">Leading word</td><td>00 to 07</td><td>The error code (2 digits) that is output to AR 253 bits 00 to 07 is output.</td></tr>
<tr><td>08 and 09</td><td>CPM2B-S operating mode
<table><tr><th>Bit</th><th>09</th><th>08</th></tr><tr><td>PROGRAM mode</td><td>0</td><td>0</td></tr><tr><td>MONITOR mode</td><td>1</td><td>0</td></tr><tr><td>RUN mode</td><td>1</td><td>1</td></tr></table></td></tr>
<tr><td>10</td><td>Not used.</td></tr>
<tr><td>11</td><td>UM area write-protection (Mirrors the status of PC Setup setting in DM 6602 bits 00 to 03.)
OFF: UM writable
ON: UM write-protected</td></tr>
<tr><td>12 and 13</td><td>Not used.</td></tr>
<tr><td>14</td><td>ON when a non-fatal error has occurred.</td></tr>
<tr><td>15</td><td>ON when a fatal error has occurred.</td></tr>
<tr><td rowspan="13">Leading word + 1</td><td>00 to 03</td><td>Not used.</td></tr>
<tr><td>04</td><td>ON when a battery error has occurred.
(Effective only when detection of battery errors is enabled with the PC Setup setting in DM 6655 bits 12 to 15 set to 0.)</td></tr>
<tr><td>05</td><td>ON when a cycle time overrun error has occurred.</td></tr>
<tr><td>06</td><td>Not used.</td></tr>
<tr><td>07</td><td>ON when FAL(06) was executed or a PC Setup settings error has occurred.
(The FAL number is transmitted in bits 00 to 07 of the leading word.)</td></tr>
<tr><td>08</td><td>ON when a memory error has occurred.</td></tr>
<tr><td>09</td><td>ON when there isn't an END(01) instruction in the program.</td></tr>
<tr><td>10</td><td>Not used.</td></tr>
<tr><td>11</td><td>ON when an I/O Unit over error (too many Units) has been detected.</td></tr>
<tr><td>12 and 13</td><td>Not used.</td></tr>
<tr><td>14</td><td>ON when an I/O bus error has occurred.</td></tr>
<tr><td>15</td><td>ON when FALS(07) was executed.
(The FAL number is transmitted in bits 00 to 07 of the leading word.)</td></tr>
</table>

Note If words in any areas other than the IR area (IR 000 to IR 227) or LR area (LR 00 to LR 15) are allocated to the I/O Link Read area, the data may not be cleared even when the power is interrupted, possibly causing data from immediately before power interruption to be read by the master. If this creates a potential problem, use the following measures to eliminate the problem.

- When starting in RUN or MONITOR mode, configure the ladder program so that the Read area is rewritten with appropriate data.
- When starting in PROGRAM mode, it will not be possible to take direct measures at the slave. Monitor the status at the master and do not read the data when the operating mode is PROGRAM mode.

When a fatal error occurs at a slave, the master may read data from immediately before the error. In this case also, monitor the status at the master and do not read the data.

SECTION 8
Cycle Time and I/O Response Time

This section explains the cycle time and I/O response time in CPM2B-S PCs. Refer to this section when writing the user program to improve operation and reduce response delays.

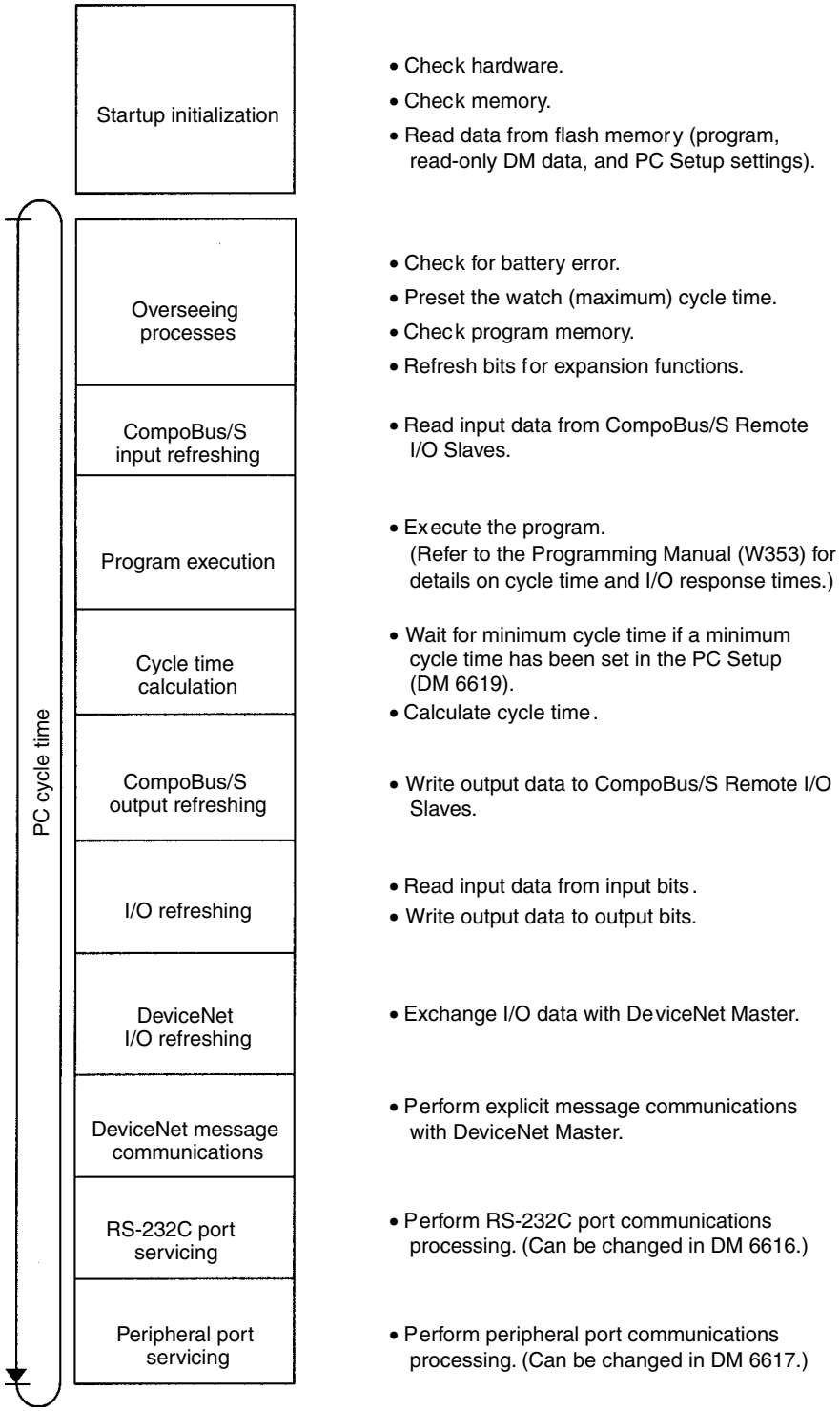
8-1 Cycle Time 118
8-1-1 Cyclic Operation and Interrupts 118
8-1-2 Cycle Time and Operations 120
8-1-3 Cycle Time Example 120
8-1-4 Instruction Execution Times 121
8-2 I/O Response Time 131
8-2-1 CPM2B-S I/O Response Time 131
8-2-2 I/O Response Time between CompoBus/S Slaves 132
8-3 Interrupt Processing Time 133
8-4 One-to-one PC Link I/O Response Time 134

8-1 Cycle Time

8-1-1 Cyclic Operation and Interrupts

Basic CPU Operation

Initialization is performed when the power is turned ON. If there are no initialization errors, the overseeing processes, program execution, I/O refreshing, and communications port servicing are performed repeatedly (cyclically).


Startup initialization
• Check hardware.
• Check memory.
• Read data from flash memory (program, read-only DM data, and PC Setup settings).
PC cycle time
Overseeing processes
• Check for battery error.
• Preset the watch (maximum) cycle time.
• Check program memory.
• Refresh bits for expansion functions.
CompoBus/S input refreshing
• Read input data from CompoBus/S Remote I/O Slaves.
Program execution
• Execute the program. (Refer to the Programming Manual (W353) for details on cycle time and I/O response times.)
Cycle time calculation
• Wait for minimum cycle time if a minimum cycle time has been set in the PC Setup (DM 6619).
• Calculate cycle time.
CompoBus/S output refreshing
• Write output data to CompoBus/S Remote I/O Slaves.
I/O refreshing
• Read input data from input bits.
• Write output data to output bits.
DeviceNet I/O refreshing
• Exchange I/O data with DeviceNet Master.
DeviceNet message communications
• Perform explicit message communications with DeviceNet Master.
RS-232C port servicing
• Perform RS-232C port communications processing. (Can be changed in DM 6616.)
Peripheral port servicing
• Perform peripheral port communications processing. (Can be changed in DM 6617.)

Note 1. The cycle time can be read using a Programming Device.

2. The maximum cycle time and current cycle time are stored in AR 14 and AR 15 respectively.
3. The cycle time varies with the processing required and so it is possible that the calculated value and the actual value may not be the same.

Process	Content	Time requirements
Overseeing	Set cycle watchdog timer, check I/O bus, check UM, refresh clock, refresh bits allocated to new functions.	0.3 ms
Wait for completion of CompoBus/S communications	Wait for completion of the CompoBus/S communications started in the CompoBus/S output refreshing process.	---
CompoBus/S input refreshing	Read input data from CompoBus/S Master ASIC.	0.02 ms
Program execution	Execute user program.	Total time for executing instructions. (Varies according to content of user's program.)
Cycle time calculation	Wait until minimum cycle time has elapsed if a minimum cycle time is set in DM 6619 of PC Setup. Calculate of cycle time.	Negligible except for the delay itself when required.
CompoBus/S output refreshing	Write output data to CompoBus/S Master ASIC. Start CompoBus/S communications.	0.05 ms
I/O output refreshing	Write output data (results of executing program) to output bits.	CPM2B-S CPU Unit:0.06 ms Expansion I/O Unit:0.3 ms
I/O input refreshing	Read input data from input bits.	
DeviceNet I/O refreshing	Write output data to DeviceNet interface and read input data.	0.1 ms
RS-232C port servicing	Communications processing when a Programming Device or Communications Adapter is connected to the RS-232C port.	0.55 ms min., 5% or less of cycle time up to 131 ms (The percentage of cycle time allocated to RS-232C servicing can be set in DM 6616.)
Peripheral port servicing	Service device connected to peripheral port when a Programming Device or Adapter is connected.	0.55 ms min., 5% or less of cycle time up to 131 ms (The percentage of cycle time allocated to peripheral port servicing can be set in DM 6617.)
DeviceNet communications servicing	Perform communications processing (explicit message communications) with the DeviceNet Master.	65.536 ms max.

Note
1. The CPM2B-S starts I/O refreshing after CompoBus/S communications are completed. If the cycle time is shorter than the CompoBus/S communications response time, the CPU will wait until CompoBus/S communications are completed before starting I/O refreshing again. In effect, this delay results in a minimum cycle time equivalent to the CompoBus/S communications response time.
2. Even if the CompoBus/S is not used, the cycle time will never be shorter than the CompoBus/S communications response time.
3. The cycle time will be affected if there is a connection to a DeviceNet network (-DRT models only). Adjust the system while connected to the DeviceNet network.

8-1-2 Cycle Time and Operations

The effects of the cycle time on operations are as shown below. When a long cycle time is affecting operation, either reduce the cycle time or improve responsiveness with interrupt programs.

Cycle time	Operation conditions
1 ms or longer	TMHH(– –) may be inaccurate when TC 000 through TC 003 or TC 008 through TC 255 are used (operation will be normal for TC 004 through TC 007).
10 ms or longer	TIMH(15) may be inaccurate when TC 004 through TC 255 are used (operation will be normal for TC 000 through TC 003).
20 ms or longer	Programming using the 0.02-second Clock Bit (SR 25401) may be inaccurate.
100 ms or longer	TIM may be inaccurate. Programming using the 0.1-second Clock Bit (SR 25500) may be inaccurate. A CYCLE TIME OVER error is generated (SR 25309 will turn ON).
120 ms or longer	The FALS 9F monitoring time SV is exceeded. A system error (FALS 9F) is generated, and operation stops.
200 ms or longer	Programming using the 0.2-second Clock Bit (SR 25501) may be inaccurate.

8-1-3 Cycle Time Example

In this example, the cycle time is calculated for a Unit. The I/O is configured as follows:

6 inputs: 1 word (00000 to 00005)
4 outputs: 1 word (01000 to 01003)

The rest of the operating conditions are assumed to be as follows:

User's program: 500 instructions (consists of only LD and OUT)
Cycle time: Variable (no minimum set)

The average processing time for a single instruction in the user's program is assumed to be 1.26 μs. The cycle times are as shown in the following table.

Process	Calculation method	Time when peripheral port is used	Time when peripheral port is not used
1. Overseeing	---	0.3 ms	0.3 ms
2. Wait for completion of CompoBus/S communications	---	0	0.5 ms
3. CompoBus/S input refreshing	---	0.02 ms	0.02 ms
4. Program execution	1.26 × 500 (μs)	0.6 ms	0.6 ms
5. Cycle time calculation	---	0	0
6. CompoBus/S output refreshing	---	0.05 ms	0.05 ms
7. I/O refreshing	---	0.06 ms	0.06 ms
8. DeviceNet I/O refreshing	---	0.1 ms	0.1 ms
9. Peripheral port servicing	---	0.55 ms	0
10. RS-232C port servicing	---	0	0
11. DeviceNet communications servicing	---	0	0
Total cycle time	(1) + (2) + (3) + - - - + (11)	1.68 ms	1.63 ms

Note 1. The CompoBus/S communications wait time can be calculated by subtracting the time required for processes 9, 10, 11, and 1 from the CompoBus/S communications response time.

CompoBus/S wait time = CompoBus/S response time – (9) – (10) – (11) – (1)

When the peripheral port is being used in the example above, the calculation result is negative and the CompoBus/S wait time is negligible.

Communications mode	Max. number of nodes setting	CompoBus/S communications response time
High-speed mode	16	0.5 ms
	32	0.8 ms
Long-distance mode	16	4.0 ms
	32	6.0 ms

2. The cycle time can be read from a Programming Device.
3. AR 14 contains the max. cycle time and AR 15 contains the current cycle time.
4. The actual cycle time will vary slightly from the calculated value due to variations in processing from cycle to cycle.

If the cycle time is shorter than the CompoBus/S communications response time, the actual cycle time will be equal to the CompoBus/S communications response time. With short cycle times, the CompoBus/S communications response time will become the minimum cycle time; this is especially true when long-distance mode is being used.

8-1-4 Instruction Execution Times

The following table lists the execution times for CPM2B-S instructions.

Basic Instructions

Code	Mnemonic	ON execution time (μs)	Conditions (Top: min.; bottom: max.)	OFF execution time (μs)		
				RSET	IL	JMP
--- ---	LD LD NOT	0.64	Any	---		
--- --- --- ---	AND AND NOT OR OR NOT	0.52				
--- ---	AND LD OR LD	0.26				
--- ---	OUT OUT NOT	1.88				
---	SET	2.58				
---	RSET					
---	TIM	4.76	Constant for SV	7.8	7.6	2.9
			∗DM for SV	15.6	15.4	2.9
---	CNT	4.50	Constant for SV	6.8	2.9	3.1
			∗DM for SV	14.5	2.9	3.1

Special Instructions

Code	Mnemonic	ON execution time (μs)	Conditions (Top: min.; bottom: max.)	OFF execution time (μs)		
00	NOP	0.15	Any			
01	END	6.2				
02	IL	1.1		2.1		
03	ILC	1.6		1.6		
04	JMP	0.95		1.8		
05	JME	2.1		2.1		
06	FAL	20.5		2.5		
07	FALS	2.9		2.5		
08	STEP	7.3		6.0		
09	SNXT	5.1		3.6		
10	SFT			Reset	IL	JMP
		10.4	With 1-word shift register	9.2	0.98	0.98
		15.3	With 10-word shift register	11.9	1.0	1.0
		39.6	With 53-word shift register	26.2	1.0	1.0
11	KEEP	3.2	Any	Reset	IL	JMP
				3.1	1.2	1.3
12	CNTR			Reset	IL	JMP
		10.9	Constant for SV	7.9	5.5	5.6
		18.8	*DM for SV			
13	DIFU	5.5	Any	Shift	IL	JMP
				5.1	4.8	0.96
14	DIFD	5.3	Any	Shift	IL	JMP
				5.4	4.7	0.97
15	TIMH			Reset	IL	JMP
		9.0	Regular execution, constant for SV	13.0	12.6	6.1
		9.6	Interrupt execution, constant for SV	14.4	14.0	7.5
		9.8	Regular execution, *DM for SV	20.8	20.5	6.1
		10.7	Interrupt execution, *DM for SV	22.2	22.0	7.5
16	WSFT	14.0	With 1-word shift register	2.6		
		18.6	With 10-word shift register			
		1.15 ms	With 2,048-word shift register using *DM			
17	ASFT	13.0	Shifting 1 word	2.6		
		22.9	Shifting 10 words			
		1.51 ms	Shifting 2,048 words via *DM			
20	CMP	7.0	When comparing a constant to a constant	2.6		
		8.3	When comparing two words			
		12.1	When comparing two *DM			
21	MOV	7.8	When transferring a constant to a word	2.6		
		8.4	When transferring from one word to another			
		22.8	When transferring *DM to *DM			
22	MVN	7.9	When transferring a constant to a word	2.6		
		8.4	When transferring from one word to another			
		22.8	When transferring *DM to *DM			
23	BIN	15.8	When converting a word to a word	2.6		
		30.3	When converting *DM to *DM			
24	BCD	14.6	When converting a word to a word	2.6		
		29.0	When converting *DM to *DM			

Code	Mnemonic	ON execution time (μs)	Conditions (Top: min.; bottom: max.)	OFF execution time (μs)
25	ASL	8.6	When shifting a word	2.5
		15.8	When shifting *DM	
26	ASR	8.4	When shifting a word	2.5
		15.6	When shifting *DM	
27	ROL	7.3	When rotating a word	2.5
		14.5	When rotating *DM	
28	ROR	7.3	When rotating a word	2.5
		14.5	When rotating *DM	
29	COM	8.9	When inverting a word	2.5
		16.1	When inverting *DM	
30	ADD	14.7	Constant + constant → word	2.6
		16.0	Word + word → word	
		37.6	*DM + *DM → *DM	
31	SUB	14.6	Constant – constant → word	2.6
		15.8	Word – word → word	
		37.5	*DM – *DM → *DM	
32	MUL	26.8	Constant × constant → word	2.6
		28.3	Word × word → word	
		51.0	*DM × *DM → *DM	
33	DIV	25.9	Constant ÷ constant → word	2.6
		27.5	word ÷ word → word	
		50.1	*DM ÷ *DM → *DM	
34	ANDW	12.3	Constant ∩ constant → word	2.6
		13.8	Word ∩ word → word	
		35.4	*DM ∩ *DM → *DM	
35	ORW	12.3	Constant V constant → word	2.6
		13.8	Word V word → word	
		35.4	*DM V *DM → *DM	
36	XORW	12.3	Constant ⊻ constant → word	2.6
		13.8	Word ⊻ word → word	
		35.4	*DM ⊻ *DM → *DM	
37	XNRW	12.3	Constant $\overline{⊻}$ constant → word	2.6
		13.8	Word $\overline{⊻}$ word → word	
		35.5	*DM $\overline{⊻}$ *DM → *DM	
38	INC	8.8	When incrementing a word	2.5
		15.9	When incrementing *DM	
39	DEC	8.9	When decrementing a word	2.5
		16.1	When decrementing *DM	
40	STC	3.0	Any	2.5
41	CLC	3.0		2.5
46	MSG	9.9	With message in words	2.5
		17.8	With message in *DM	
47	RXD	71.9	Word specification, 1 byte input	2.6
		314.5	*DM specification, 256 bytes input	
48	TXD	32.4	Word specification, 1 byte input, RS-232C	2.6
		264.5	*DM specification, 256 bytes input, RS-232C	
		27.7	Word specification, 1 byte input, Host Link	
		42.2	*DM specification, 256 bytes input, Host Link	

Code	Mnemonic	ON execution time (μs)	Conditions (Top: min.; bottom: max.)	OFF execution time (μs)
50	ADB	14.1	Constant + constant → word	2.6
		15.6	Word + word → word	
		37.4	∗DM + ∗DM → ∗DM	
51	SBB	14.4	Constant – constant → word	2.6
		15.9	Word – word → word	
		37.7	∗DM – ∗DM → ∗DM	
52	MLB	16.8	Constant × constant → word	2.6
		18.5	Word × word → word	
		41.2	∗DM × ∗DM → ∗DM	
53	DVB	16.9	Constant ÷ constant → word	2.6
		18.6	Word ÷ word → word	
		41.3	∗DM ÷ ∗DM → ∗DM	
54	ADDL	25.3	Word + word → word	2.6
		48.6	∗DM + ∗DM → ∗DM	
55	SUBL	25.3	Word – word → word	2.6
		48.6	∗DM – ∗DM → ∗DM	
56	MULL	79.1	Word × word → word	2.6
		102.1	∗DM × ∗DM → ∗DM	
57	DIVL	73.9	Word ÷ word → word	2.6
		98.6	∗DM ÷ ∗DM → ∗DM	
58	BINL	23.9	When converting word data to a word	2.6
		38.5	When converting ∗DM to ∗DM	
59	BCDL	19.1	When converting word data to a word	2.6
		33.7	When converting ∗DM to ∗DM	
60	CMPL	14.8	Comparing words	2.6
		30.6	Comparing ∗DM	
61	INI	68.8	Starting high-speed counter comparison	2.6
		12.0	Stopping high-speed counter comparison	
		43.3	Specifying a constant when changing high-speed counter PV	
		51.8	Specifying ∗DM when changing high-speed counter PV	
		42.8	Specifying increment mode via constant	
		50.8	Specifying increment mode via ∗DM	
		60.1	Stopping pulse output	
		42.7	Specifying a constant when changing pulse output PV	
		50.7	Specifying ∗DM when changing pulse output PV	
		17.8	Stopping synchronized control of high-speed counter	
		20.0	Specifying a constant when changing interrupt counter PV	
		27.6	Specifying ∗DM when changing interrupt counter PV	

Code	Mnemonic	ON execution time (μs)	Conditions (Top: min.; bottom: max.)	OFF execution time (μs)
62	PRV	36.9	Reading high-speed counter PV via word	2.6
		44.7	Reading high-speed counter PV *DM	
		36.6	Specifying increment mode via word	
		44.3	Specifying increment mode via *D	
		38.5	Specifying a word when using synchronized control	
		46.2	Specifying *DM when using synchronized control	
		20.2	Reading high-speed counter pulse output status via word	
		27.4	Reading high-speed counter pulse output status via *DM	
		24.4	Reading high-speed counter read range comparison results via word	
		32.4	Reading high-speed counter read range comparison results via *DM	
		39.9	Reading pulse output PV via word	
		47.8	Reading pulse output PV via *DM	
		20.1	Reading interrupt counter PV via word	
		27.1	Reading interrupt counter PV via *DM	

Code	Mnemonic	ON execution time (μs)	Conditions (Top: min.; bottom: max.)	OFF execution time (μs)
63	CTBL	186.0	Registering a target value comparison table and starting comparison in incrementing/decrementing pulse input mode via word	2.6
		807.5	Registering a target value comparison table and starting comparison in incrementing/decrementing pulse input mode via *DM	
		185.8	Registering a target value comparison table and starting comparison in incrementing mode via word	
		781.9	Registering a target value comparison table and starting comparison in incrementing mode via *DM	
		410.0	Registering a range comparison table and starting comparison in incrementing/decrementing pule input mode via word	
		418.9	Registering a range comparison table and starting comparison in incrementing/decrementing pule input mode via *DM	
		380.6	Registering a range comparison table and starting comparison in incrementing mode via word	
		399.7	Registering a range comparison table and starting comparison in incrementing mode via *DM	
		183.4	Only registering a target value comparison table in incrementing/decrementing pulse input mode via word	
		810.3	Only registering a target value comparison table in incrementing/decrementing pulse input mode via *DM	
		182.4	Only registering a target value comparison table in incrementing mode via word	
		776.3	Only registering a target value comparison table in incrementing mode via *DM	
		351.0	Only registering a range comparison table in incrementing/decrementing pule input mode via word	
		359.1	Only registering a range comparison table in incrementing/decrementing pule input mode via *DM	
		331.2	Only registering a range comparison table in incrementing mode via word	
		335.9	Only registering a range comparison table in incrementing mode via *DM	
64	SPED	44.6	Specifying a constant in independent mode	2.6
		53.8	Specifying *DM in independent mode	
		42.9	Specifying a constant in continuous pulse output mode	
		52.0	Specifying *DM in continuous pulse output mode	
		34.1	Specifying a word when changing output frequency	
		39.8	Specifying *DM when changing output frequency	

Code	Mnemonic	ON execution time (μs)	Conditions (Top: min.; bottom: max.)	OFF execution time (μs)
65	PULS	38.4	Specifying a relative pulse for the set pulse output via a word	2.6
		46.6	Specifying a relative pulse for the set pulse output via *DM	
		40.0	Specifying an absolute pulse for the set pulse output via a word	
		48.1	Specifying an absolute pulse for the set pulse output via *DM	
66	SCL	37.9	Specifying a parameter word; constant to word	2.6
		39.2	Specifying a parameter word; word to word	
		59.9	Specifying a parameter *DM; *DM to *DM	
67	BCNT	24.9	When counting 1 word	2.6
		4.32 ms	When counting 2,048 words via *DM	
68	BCMP	35.3	Comparing constant, results to word	2.6
		38.3	Comparing word, results to word	
		58.1	Comparing *DM, results to *DM	
69	STIM	25.7	Constant-set one-shot interrupt start	2.6
		47.8	*DM-set one-shot interrupt start	
		25.9	Constant-set scheduled interrupt start	
		47.8	*DM-set scheduled interrupt start	
		34.0	Constant-set timer read	
		46.4	*DM-set timer read	
		10.6	Stopping timer	
70	XFER	21.3	When transferring a constant to a word	2.6
		23.8	When transferring a word to a word	
		1.52 ms	When transferring 2,048 words using *DM	
71	BSET	13.8	When setting a constant to a word	2.6
		14.3	When setting a word to a word	
		971.1	When setting *DM to 2,048 words	
73	XCHG	14.5	Word → word	2.6
		29.3	*DM → *DM	
74	SLD	12.3	Shifting 1 word	2.6
		23.9	Shifting 10 words	
		2.83 ms	Shifting 2,048 words using *DM	
75	SRD	12.3	Shifting 1 word	2.6
		23.9	Shifting 10 words	
		2.83 ms	Shifting 2,048 words using *DM	
76	MLPX	16.8	When decoding word to word	2.6
		46.1	When decoding *DM to *DM	
77	DMPX	19.7	When encoding word to word	2.6
		52.1	When encoding *DM to *DM	
78	SDEC	19.8	When decoding word to word	2.6
		48.3	When decoding *DM to *DM	
80	DIST	18.7	When setting a constant to a word + a word	2.6
		20.2	When setting a word to a word + a word	
		43.1	When setting *DM to *DM +*DM	
		31.0	When setting a constant to a stack	
		32.7	When setting a word to a stack	
		55.9	When setting *DM to a stack via *DM	

Code	Mnemonic	ON execution time (μs)	Conditions (Top: min.; bottom: max.)	OFF execution time (μs)
81	COLL	21.5	When setting a constant + a word to a word	2.6
		21.9	When setting a word + a word to a word	
		42.5	When setting *DM + *DM to *DM	
		31.5	When setting a word + constant to FIFO stack	
		32.0	When setting a word + word to FIFO stack	
		784.7	When setting a *DM + *DM to FIFO stack via *DM	
		33.6	When setting a word + constant to LIFO stack	
		34.0	When setting a word + word to LIFO stack	
		57.1	When setting a *DM + *DM to LIFO stack via *DM	
82	MOVB	17.3	When transferring a constant to a word	2.6
		18.0	When transferring from one word to another	
		41.7	When transferring *DM to *DM	
83	MOVD	13.8	When transferring a constant to a word	2.6
		16.2	When transferring from one word to another	
		38.1	When transferring *DM to *DM	
84	SFTR	22.8	Shifting 1 word	2.6
		24.3	Shifting 10 words	
		1.15 ms	Shifting 2,048 words using *DM	
85	TCMP	27.5	Comparing constant to word-set table	2.6
		28.0	Comparing word to word-set table	
		48.3	Comparing *DM to *DM-set table	
86	ASC	19.1	Word → word	2.6
		52.2	*DM → *DM	
89	INT	22.1	Set masks via word	2.6
		30.1	Set masks via *DM	
		18.4	Clear interrupts via word	
		26.4	Clear interrupts via *DM	
		17.2	Read mask status via word	
		24.1	Read mask status via *DM	
		23.1	Change counter SV via word	
		31.1	Change counter SV via *DM	
		10.7	Mask all interrupts via word	
		10.7	Mask all interrupts via *DM	
		11.0	Clear all interrupts via word	
		11.0	Clear all interrupts via *DM	
91	SBS	10.8	Any	2.6
92	SBN	---		0.76
93	RET	6.2		1.0
97	IORF	16.8	Refreshing IR 000	2.8
		130.7	Refreshing one input word	
		110.7	Refreshing one output word	
99	MCRO	26.1	With word-set I/O operands	2.6
		42.3	With *DM-set I/O operands	

Expansion Instructions without Default Function Codes

Code	Mnemonic	ON execution time (μs)	Conditions (Top: min.; bottom: max.)	OFF execution time (μs)
---	ACC	66.5	When specifying a word in independent mode and CW/CCW mode	2.6
		92.1	When specifying *DM in independent mode and CW/CCW mode	
		66.2	When specifying a word in independent mode and Feed/Dir mode	
		92.2	When specifying *DM in independent mode and Feed/Dir mode	
		65.5	When executing the word designation in CW continuous mode and CW/CCW mode	
		75.0	When executing the *DM designation in CW continuous mode and CW/CCW mode	
		45.4	When changing the word designation in CW continuous mode and CW/CCW mode	
		53.8	When changing the *DM designation in CW continuous mode and CW/CCW mode	
		65.5	When executing the word designation in CCW continuous mode and CW/CCW mode	
		75.0	When executing the *DM designation in CCW continuous mode and CW/CCW mode	
		45.5	When changing the word designation in CCW continuous mode and CW/CCW mode	
		53.6	When changing the *DM designation in CCW continuous mode and CW/CCW mode	
		65.0	When executing the word designation in CW continuous mode and Feed/Dir mode	
		74.5	When executing the *DM designation in CW continuous mode and Feed/Dir mode	
		45.4	When changing the word designation in CW continuous mode and Feed/Dir mode	
		53.5	When changing the *DM designation in CW continuous mode and Feed/Dir mode	
		65.4	When executing the word designation in CCW continuous mode and Feed/Dir mode	
		74.8	When executing the *DM designation in CCW continuous mode and Feed/Dir mode	
		45.5	When changing the word designation in CCW continuous mode and Feed/Dir mode	
		53.6	When changing the *DM designation in CCW continuous mode and Feed/Dir mode	
---	AVG	23.2	Average for 1 cycle (constant designation)	3.2
		23.9	Average for 1 cycle (word designation)	
		84.2	Average for 64 cycles (*DM designation)	
---	FCS	27.6	Adding one word and outputting to word	2.6
		592.3	Adding 999 words and outputting to *DM	
---	HEX	25.8	Word → Word	2.6
		72.2	*DM → *DM	
---	HMS	30.7	When converting word to word	2.6
		45.0	When converting *DM to *DM	
---	MAX	21.9	Searching one word and outputting to word	2.6
		713.9	Searching 999 words and outputting to *DM	

Code	Mnemonic	ON execution time (μs)	Conditions (Top: min.; bottom: max.)	OFF execution time (μs)		
---	MIN	21.9	Searching one word and outputting to word	2.6		
		713.9	Searching 999 words and outputting to *DM			
---	NEG	12.0	Converting constant to word	3.0		
		12.8	Converting word to word			
		28.3	Converting *DM to *DM			
---	PID	392.5	Initializing word to word	3.3		
		418.8	Initializing *DM to *DM			
		29.3	Sampling word to word			
		58.7	Sampling *DM to *DM			
---	PWM	30.3	Constant for pulse width ratio	2.6		
		43.4	Word for pulse width ratio			
		46.0	*DM for pulse width ratio			
---	SCL2	35.1	Parameter word designation, word to word	2.6		
		59.3	Parameter *DM designation, *DM to *DM			
---	SCL3	37.1	Parameter word designation, word to word	2.6		
		62.3	Parameter *DM designation, *DM to *DM			
---	SEC	29.8	Converting from word to word	2.6		
		44.0	Converting from *DM to *DM			
---	SRCH	28.9	Searching one word and outputting to a word	2.6		
		1.40 ms	*DM specification, searching 2,048 words and outputting to *DM			
---	STUP	3.42 ms	Constant specification, executed first scan	2.6		
		34.1	Constant specification, executed second scan or later			
		3.44 ms	*DM specification, executed first scan			
		39.8	*DM specification, executed second scan or later			
---	SUM	22.8	Word added and output to word	2.6		
		1.44 ms	*DM specification, 999 bytes added and output to *DM			
---	SYNC	34.6	Constant ratio specification, when executed	2.6		
		35.3	Word ratio specification, when executed			
		42.5	*DM ratio specification, when executed			
		25.3	Word ratio specification, when changed			
		32.6	*DM ratio specification, when changed			
---	TIML			Reset	IL	JMP
		12.8	Normal execution, constant specification	17.9	17.5	8.1
		13.5	Interrupt execution, constant specification	25.7	25.5	8.1
---	TMHH			Reset	IL	JMP
		12.3	Normal execution, constant specification	15.6	15.1	7.4
		12.7	Interrupt execution, constant specification	17.2	16.9	9.1
		12.7	Normal execution, *DM specification	23.6	23.3	7.7
		13.6	Interrupt execution, *DM specification	25.1	24.7	9.1
---	ZCP	9.4	Comparing a constant to a constant range and output to word	2.6		
		11.8	Comparing a word to a word range and output to word			
		33.4	Comparing *DM to *DM and output to *DM			

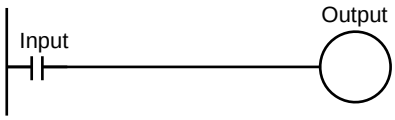
Code	Mnemonic	ON execution time (μs)	Conditions (Top: min.; bottom: max.)	OFF execution time (μs)
---	ZCPL	19.5	Comparing a word to a word range	2.6
		45.2	Comparing ∗DM to ∗DM	

8-2 I/O Response Time

8-2-1 CPM2B-S I/O Response Time

The I/O response time is the time it takes after an input signal has been received (i.e., after an input bit has turned ON) for the PC to check and process the information and to output a control signal (i.e., to output the result of the processing to an output bit). The I/O response time varies according to the timing and processing conditions.

The minimum and maximum I/O response times are shown here, using the following program as an example.

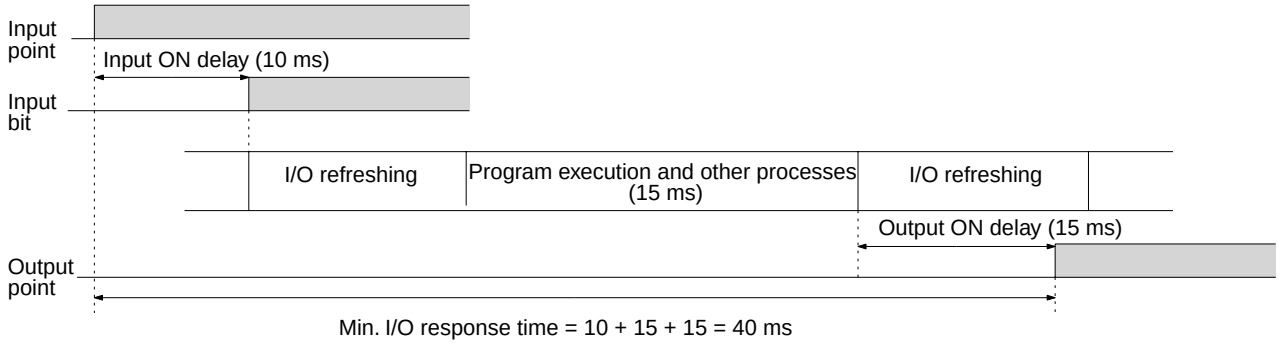


The following conditions are taken as examples for calculating the I/O response times.

Input ON delay:	10 ms (input time constant: default setting)
Overseeing time:	1 ms (includes I/O refreshing)
Instruction execution time:	14 ms
Output ON delay:	15 ms
Communications ports:	Not used.

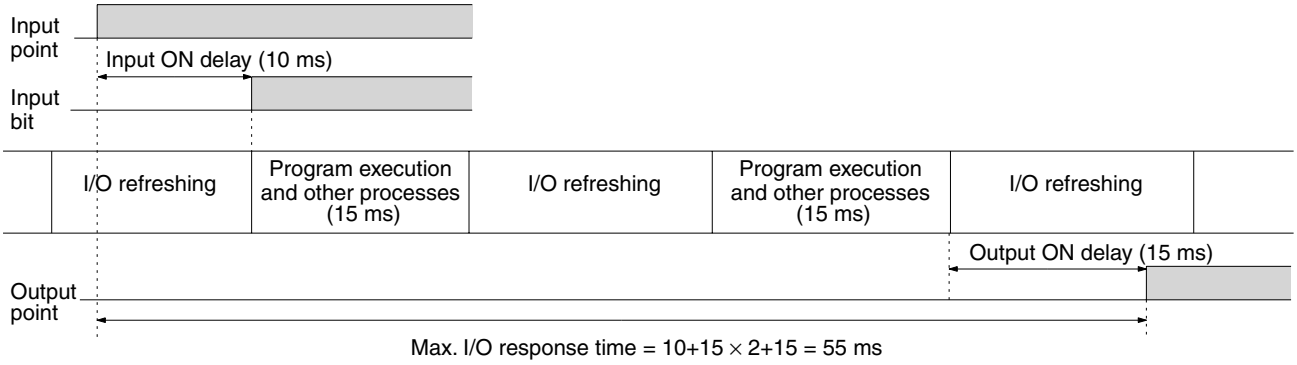
Minimum I/O Response Time

The CPM2B-S responds most quickly when it receives an input signal just prior to I/O refreshing, as shown in the illustration below.


Input point
Input ON delay (10 ms)
Input bit
I/O refreshing
Program execution and other processes (15 ms)
I/O refreshing
Output ON delay (15 ms)
Output point
Min. I/O response time = 10 + 15 + 15 = 40 ms

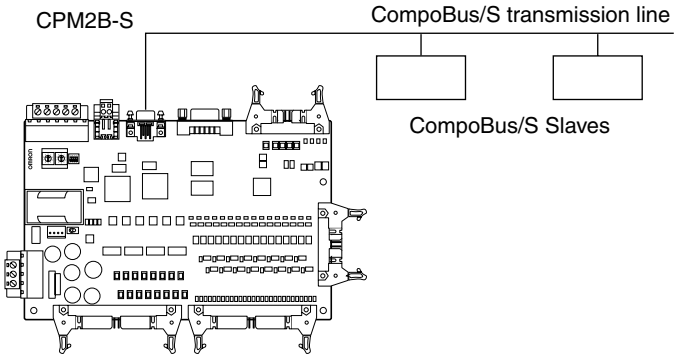
Maximum I/O Response Time

The CPM2B-S takes longest to respond when it receives the input signal just after the input refresh phase of the cycle, as shown in the illustration below. In that case, a delay of approximately one cycle will occur.


Input point
Input ON delay (10 ms)
Input bit
I/O refreshing
Program execution and other processes (15 ms)
I/O refreshing
Program execution and other processes (15 ms)
I/O refreshing
Output ON delay (15 ms)
Output point
Max. I/O response time = 10+15 × 2+15 = 55 ms

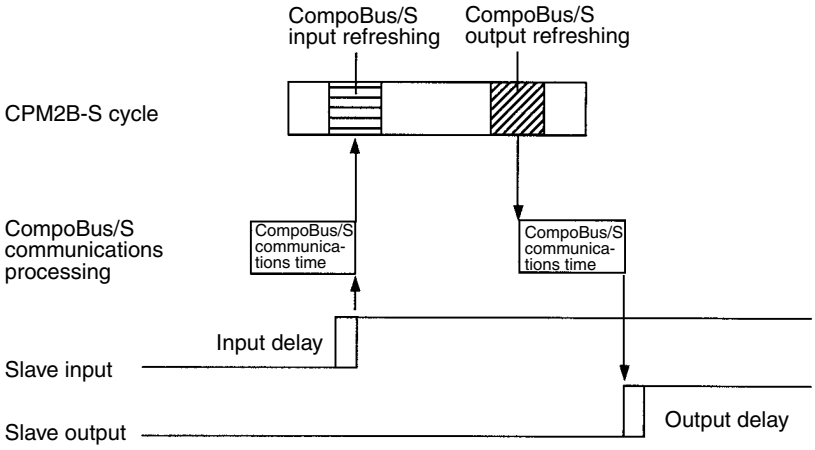
8-2-2 I/O Response Time between CompoBus/S Slaves

The I/O response time between CompoBus/S Slaves depends on the cycle time and I/O timing.



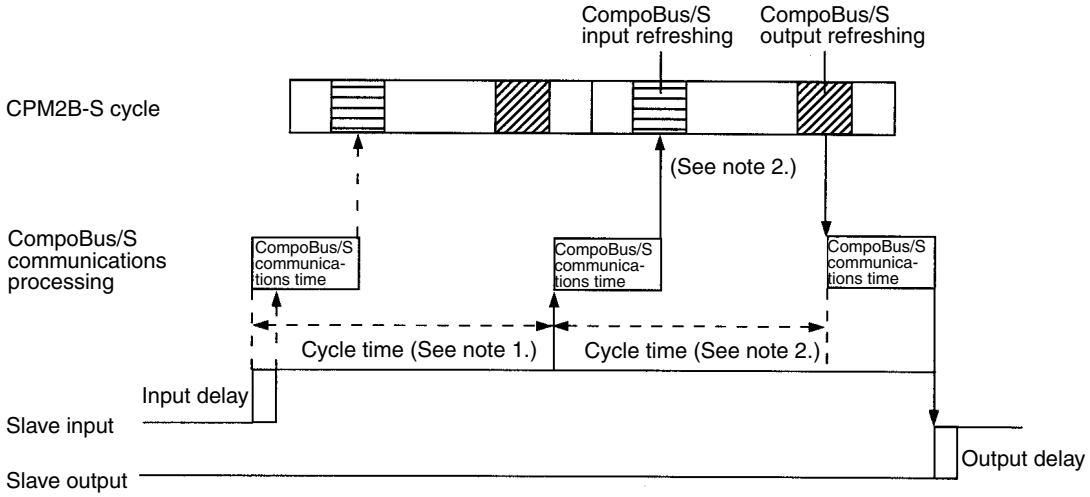
Minimum I/O Response Time

The minimum I/O response time is the CPM2B-S program execution time plus the cycle time calculation time.



Maximum I/O Response Time

The maximum I/O response time is as follows:
(2 × CPM2B-S cycle time) + CompoBus/S communications time + CompoBus/S Slave input delay + CompoBus/S Slave output delay



Note The Slave input is not read for almost one PC cycle because it goes ON just after the start of CompoBus/S communications processing (*1). The input is read during the next CompoBus/S communications processing cycle (*2).

8-3 Interrupt Processing Time

This section explains the processing times involved from the time an interrupt is executed until the interrupt processing routine is called, and from the time an interrupt processing routine is completed until returning to the initial location. This explanation applies to input interrupts, interval timer interrupts, and high-speed counter interrupts.

1,2,3...

1. Interrupt source
2. Interrupt ON delay
3. Wait for completion of interrupt-mask processing
4. Change to interrupt processing
5. Execution of interrupt routine
6. Return to initial location

The table below shows the times involved from the generation of an interrupt signal until the interrupt processing routine is called, and from when the interrupt processing routine is completed until returning to the original position.

Item	Contents	Time
Interrupt ON delay	This is the delay time from the time the interrupt input bit turns ON until the time that the interrupt is executed. This delay does not apply to other interrupts.	50 μs
Wait for completion of interrupt-mask processing	When a process that disables (masks) the interrupt is being executed, this is the time required for that process to be completed.	See below.
Change to interrupt processing	This is the time it takes to change processing to the interrupt process.	10 μs
Return	This is the time it takes, from execution of RET(93), to return to the processing that was interrupted.	10 μs

Mask Processing

Interrupts are masked during processing of the operations described below. Until the processing is completed, any interrupts will remain masked for the indicated times.

Generation and clearing of non-fatal errors:

Interrupts will be masked for up to 100 μs when a non-fatal error has been generated and the error contents are being registered in the PC, or when an error is being cleared.

Online editing:

Operation will stop and interrupts will be masked for up to 600 ms (for DM 6144 to DM 6655) when online editing is executed or the settings are changed with STUP(– –) during operation. The program or PC Setup can be overwritten during that delay.

In addition to the online editing delay, interrupts may be masked for up to 150 μs for system processing.

Example Calculation

This example shows the interrupt response time (i.e., the time from when the interrupt input turns ON until the start of the interrupt processing routine) when input interrupts are used under the conditions shown below.

Minimum Response Time

	Interrupt ON delay:	50 μs
	Interrupt mask standby time:	0 μs
+	Change-to-interrupt processing:	10 μs
	Minimum response time:	60 μs

Maximum Response Time
(Except for the Online Editing of DM 6144 to DM 6655)

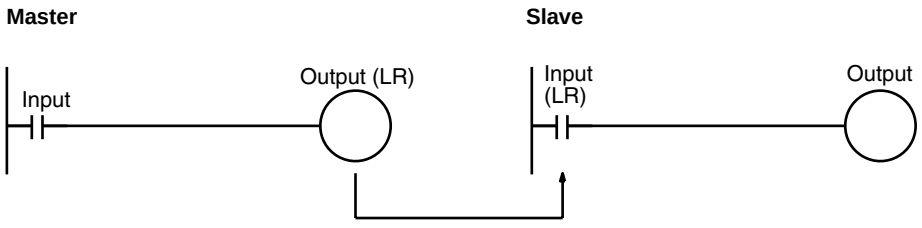
	Interrupt ON delay:	50 μs
	Interrupt mask standby time:	150 μs
+	Change-to-interrupt processing:	10 μs
	Maximum response time:	210 μs

In addition to the response time shown above, the time required for executing the interrupt processing routine itself and a return time of 10 μs must also be accounted for when returning to the process that was interrupted.

8-4 One-to-one PC Link I/O Response Time

When two CPM2B-S PCs are linked 1:1, the I/O response time is the time required for an input executed at one of the PCs to be output to the other PC by means of 1:1 PC Link communications.

The minimum and maximum I/O response times are shown here, using as an example the following instructions executed at the master and the slave. In this example, communications proceed from the master to the slave.



The following conditions are taken as examples for calculating the I/O response times. In CPM2B-S PCs, LR area words LR 00 to LR 15 are used in 1:1 data links and the transmission time is fixed at 12 ms.

Input ON delay:	10 ms (input time constant: default setting)
Master cycle time:	10 ms
Slave cycle time:	15 ms
Output ON delay:	15 ms

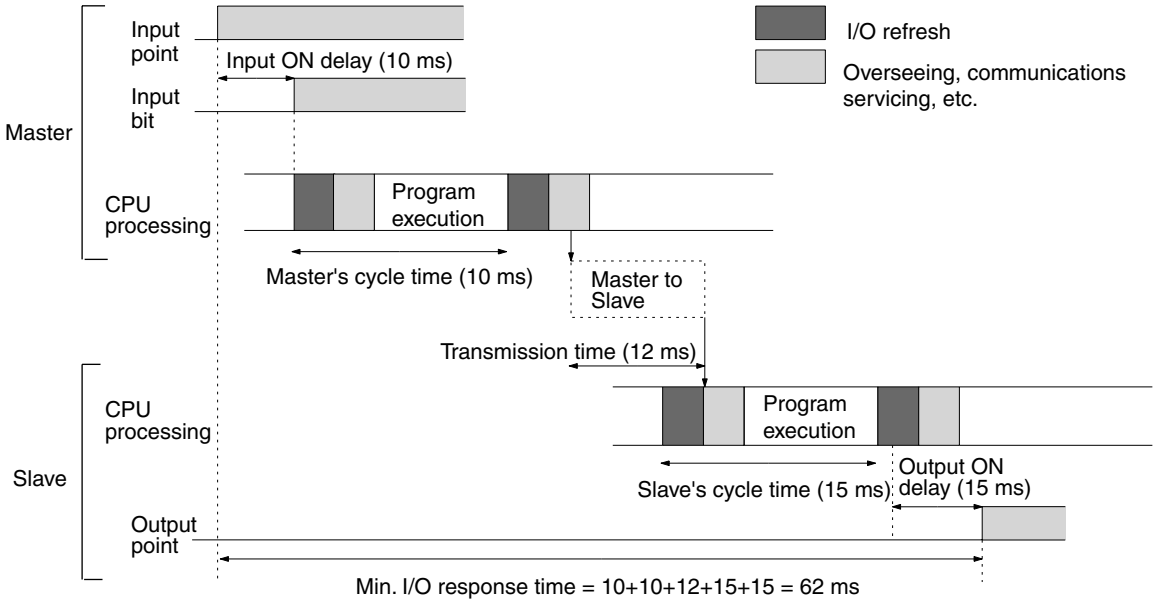
Minimum I/O Response Time

The CPM2B-S responds most quickly under the following circumstances:

1,2,3...

1. The CPM2B-S receives an input signal just prior to the input refresh phase of the cycle.
2. The Master's communications servicing occurs just as the Master-to-Slave transmission begins.
3. The Slave's communications servicing occurs just after the transmission is completed.

The minimum I/O response time = Input ON response time + Master's cycle time + Transmission time + Slave's cycle time + Output ON response time



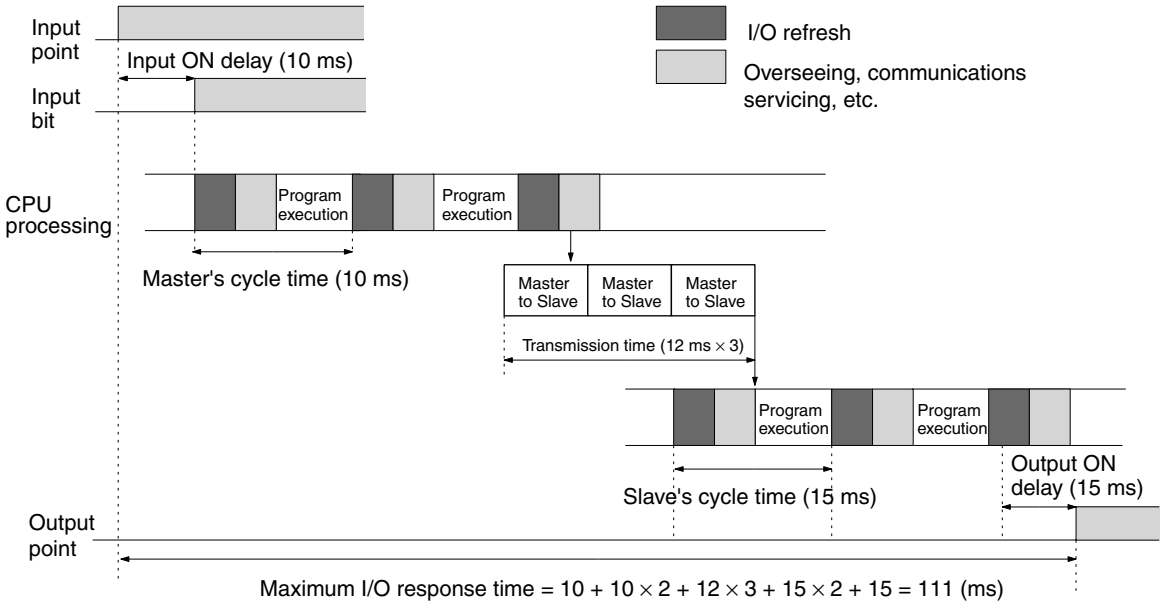
Maximum I/O Response Time

The CPM2B-S takes the longest to respond under the following circumstances:

1,2,3...

1. The CPM2B-S receives an input signal just after the input refresh phase of the cycle.
2. The Master's communications servicing just misses the Master-to-Slave transmission.
3. The transmission is completed just after the Slave's communications servicing ends.

The maximum I/O response time = Input ON response time + Master's cycle time × 2 + Transmission time × 3 + Slave's cycle time × 2 + Output ON response time


Input point
Input ON delay (10 ms)
Input bit
I/O refresh
Overseeing, communications servicing, etc.
CPU processing
Program execution
Program execution
Master's cycle time (10 ms)
Master to Slave
Master to Slave
Master to Slave
Transmission time (12 ms × 3)
Program execution
Program execution
Output ON delay (15 ms)
Slave's cycle time (15 ms)
Output point
Maximum I/O response time = 10 + 10 × 2 + 12 × 3 + 15 × 2 + 15 = 111 (ms)

SECTION 9
Test Runs and Error Processing

This section describes procedures for test runs of CPM2B-S operation, self-diagnosis functions, and error processing to identify and correct the hardware and software errors that can occur during PC operation.

9-1 Initial System Checks and Test Run Procedure 138
9-1-1 Initial System Checks 138
9-1-2 Flash Memory Precautions 138
9-2 CPM2B-S Test Run Procedure 138
9-3 Self-diagnostic Functions 139
9-3-1 Identifying Errors 139
9-3-2 User-defined Errors 140
9-3-3 Non-fatal Errors 141
9-3-4 Fatal Errors 142
9-4 Troubleshooting Flowcharts 143
9-5 Maintenance Inspections 151
9-6 Battery Replacement 151

9-1 Initial System Checks and Test Run Procedure

9-1-1 Initial System Checks

Check the following items after setting up and wiring the CPM2B-S, but before performing a test run.

Item	Points to check
Power supply and I/O connections	Is the wiring correct? Are the terminals securely tightened? Are there any shorts between crimp terminals or wires? Refer to *3-5 Wiring and Connections* for details.
Connecting cables	Are the cables all connected correctly and locked? Refer to *3-5 Wiring and Connections* for details.

Clearing Memory

Always clear memory before beginning to program the CPM2B-S. Although memory is cleared before the CPU Board is shipped, the contents of the DM, HR, AR, and counter areas may change in transit.

Operating Mode at Startup

See *1-3-3 Operating Mode at Startup* to determine what mode the CPM2B-S will enter when the power is turned on.

9-1-2 Flash Memory Precautions

Observe the following precautions to protect the flash memory and ensure proper operation.

1,2,3...

1. If changes are made in the read-only DM area (DM 6144 through DM 6599) or PC Setup (DM 6600 through DM 6655), the PC's operating mode must be changed to write the new contents to flash memory. If backup battery is replaced before the changes are written to flash memory, the changes will be lost.
   The changes can be saved by switching the CPM2B-S to RUN or MONITOR mode or turning the CPM2B-S OFF and then ON again.
2. When contents of the program, read-only DM (DM 6144 through DM 6599), or PC Setup (DM 6600 through DM 6655) have been changed, startup processing will take up to 1,200 ms longer than usual. Be sure to take this one-time startup delay into account if it may affect operations.
3. If one of the following three operations is performed in MONITOR or RUN mode, the CPM2B-S's cycle time will be extended by up to 1,200 ms and interrupts will be disabled while the program or PC Setup is being overwritten.
   - Program changes with the online edit operation
   - Changes to the read-only DM area (DM 6144 through DM 6599)
   - Changes to the PC Setup (DM 6600 through DM 6655)

   A "SCAN TIME OVER" error won't occur during these operations. Be sure to take this delay in the CPM2B-S's I/O response times into account when performing online editing.

9-2 CPM2B-S Test Run Procedure

1,2,3...

1. Power Supply Application
   a) Check the CPM2B-S's power supply voltage and terminal connections.
   b) Check the I/O devices' power supply voltage and terminal connections.
   c) Turn on the power supply and check that the "PWR" indicator lights.
   d) Use a Programming Device to set the CPM2B-S to PROGRAM mode.

2. I/O Wiring Checks
   a) With the CPM2B-S in PROGRAM mode, check the output wiring by turning on the output bits with the force set and force reset operations.
   b) Check the input wiring with the CPM2B-S's input indicators or a Programming Device's monitor operations.
3. Test Run
   a) Use a Programming Device to set the CPM2B-S to RUN or MONITOR mode and check that the "RUN" indicator lights.
   b) Check the sequence of operation with the force set/reset operations, etc.
4. Debugging

   Correct any programming errors that are detected.
5. Saving the Program
   a) Use a Programming Device to write the program to a backup floppy disk.
   b) Print out a hard copy of the program with a printer.

Note Refer to *Section 4 Using Programming Devices* for details on the Support Software and Programming Console operations.

9-3 Self-diagnostic Functions

The CPM2B-S is equipped with a variety of self-diagnostic functions to help identify and correct errors and reduce down time.

9-3-1 Identifying Errors

An error can be identified by the error message displayed on a Programming Device, error flags in the AR and SR areas, and the error code output to SR 253.

Fatal and Non-fatal Errors

PC errors are divided into 2 categories based on the severity of the errors. The status of the ERR indicator (lit or flashing) shows which type of error has occurred.

ERR Lit (Fatal Error)

Fatal errors are serious errors which stop CPM2B-S operation. There are two ways to restart operation:

- Turn the PC off and then on again.
- Use a Programming Device to switch the PC to PROGRAM mode, and read/clear the error.

ERR Flashing (Non-fatal Error)

Non-fatal errors are less serious errors which don't stop CPM2B-S operation.

Communications Errors

The LED indicators and AR area flags indicate when a CompoBus/S communications error, RS-232C port error, or peripheral port error has occurred.

CompoBus/S Communications Error

When an error occurs in CompoBus/S communications, the SD and RD indicators will be OFF and the ERC indicator will be ON. Check the Slaves and the transmission lines and restart communications.

RS-232C Port Error

When an error occurs in communications through the RS-232C port, the COMM indicator will be OFF and the RS-232C Communications Error Flag (AR 0804) will be ON. Check the cables and restart communications.

Peripheral Port Error

When an error occurs in communications through the peripheral port, the COMM indicator will be OFF and the Peripheral Port Communications Error Flag (AR 0812) will be ON. Check the cables and restart communications.

Error Messages

When an error is detected, a corresponding error message will be displayed on the Programming Console or other Programming Device connected to the PC.

Error Flags

When a hardware error is detected, the corresponding error flag in the AR or SR area will be turned ON.

Error Code

When an error is detected, a specific 2-digit hexadecimal error code is output to SR 25300 to SR 25307. The error code and time of occurrence are also output to the Error Log Area (DM 2000 to DM 2021).

⚠WARNING When the CPM2B-S's self-diagnosis function detects a fatal error or when a severe failure alarm (FALS) instruction is executed, PC operation will stop and all outputs will be turned OFF. External safety measures must be provided to ensure safety in the system. Not providing proper safety measures may result in serious accidents.

⚠WARNING Emergency stop circuits, interlock circuits, limit circuits, and similar safety measures must be provided in external control circuits (i.e., not in the Programmable Controller) to ensure safety in the system if an abnormality occurs due to malfunction of the PC or another external factor affecting the PC operation. Not providing proper safety measures may result in serious accidents.

9-3-2 User-defined Errors

There are three instructions that can be used to define errors or messages. FAL(06) causes a non-fatal error, FAL(07) causes a fatal error, and MSG(46) sends a message to the Programming Console or host computer connected to the PC.

FAILURE ALARM – FAL(06)

FAL(06) is an instruction that causes a non-fatal error. The following will occur when an FAL(06) instruction is executed:

1,2,3...

1. The ERR indicator on the CPU Board will flash. PC operation will continue.
2. The instruction's 2-digit BCD FAL number (01 to 99) will be written to SR 25300 to SR 25307.

The FAL numbers can be set arbitrarily to indicate particular conditions, but the same number should not be used as both an FAL number and an FALS number.

To clear an FAL error, correct the cause of the error and then execute FAL 00 or use a Programming Device to clear the error.

SEVERE FAILURE ALARM – FALS(07)

FALS(07) is an instruction that causes a fatal error. The following will occur when an FALS(07) instruction is executed:

1,2,3...

1. Program execution will be stopped and all outputs will be turned OFF.
2. The ERR indicator on the CPU Board will be lit.
3. The instruction's 2-digit BCD FALS number (01 to 99) will be written to SR 25300 to SR 25307.

The FALS numbers can be set arbitrarily to indicate particular conditions, but the same number should not be used as both an FAL number and an FALS number.

To clear an FALS error, use a Programming Device to switch the PC to PROGRAM Mode, correct the cause of the error, and then clear the error.

MESSAGE – MSG(46) MSG(46) is used to display a message on a Programming Device connected to the CPM2B-S. The message, which can be up to 16 characters long, is displayed when the instruction's execution condition is ON.

9-3-3 Non-fatal Errors

PC operation and program execution will continue after one or more of these errors have occurred. Although PC operation will continue, the cause of the error should be corrected and the error cleared as soon as possible.

When one of these errors occurs, the POWER and RUN indicators will remain lit and the ERR indicator will flash.

Message	FAL No.	Meaning and appropriate response
SYS FAIL FAL** (** is 01 to 99 or 9B.)	01 to 99	An FAL(06) instruction has been executed in the program. Check the FAL number to determine conditions that would cause execution, correct the cause, and clear the error.
	9B	An error has been detected in the PC Setup. Check flags AR 1300 to AR 1302, and correct as directed. AR 1300 ON: An incorrect setting was detected in the PC Setup (DM 6600 to DM 6614) when power was turned on. Correct the settings in PROGRAM Mode and turn on the power again. AR 1301 ON: An incorrect setting was detected in the PC Setup (DM 6615 to DM 6644) when switching to RUN or MONITOR mode. Correct the settings in PROGRAM Mode and switch to RUN or MONITOR mode again. AR 1302 ON: An incorrect setting was detected in the PC Setup (DM 6645 to DM 6655) during operation. Correct the settings and clear the error.
SCAN TIME OVER	F8	The cycle time has exceeded 100 ms. (SR 25309 will be ON.) This indicates that the program cycle time is longer than recommended. Reduce cycle time if possible. (The CPM2B-S can be set so that this error won't be detected.)
CompoBus/S communications error (no message)	None	An error has occurred in CompoBus/S communications. Restart after checking slaves and communications paths.
RS-232C port/peripheral port communications error	None	An error has occurred in communications between the RS-232C port or the peripheral port and peripheral devices. Restart after checking communications paths.
Battery error (no message)	F7	If the voltage of the C500-BAT08 backup battery is below the minimum level, the ERR indicator will flash and SR 25308 will be turned ON. Replace the battery. (See *9-6 Battery Replacement* for details.)

9-3-4 Fatal Errors

PC operation and program execution will stop and all outputs from the PC will be turned OFF when any of these errors have occurred. CPM2B-S operation can't be restarted until the PC is turned off and then on again or a Programming Device is used to switch the PC to PROGRAM mode and clear the fatal error.

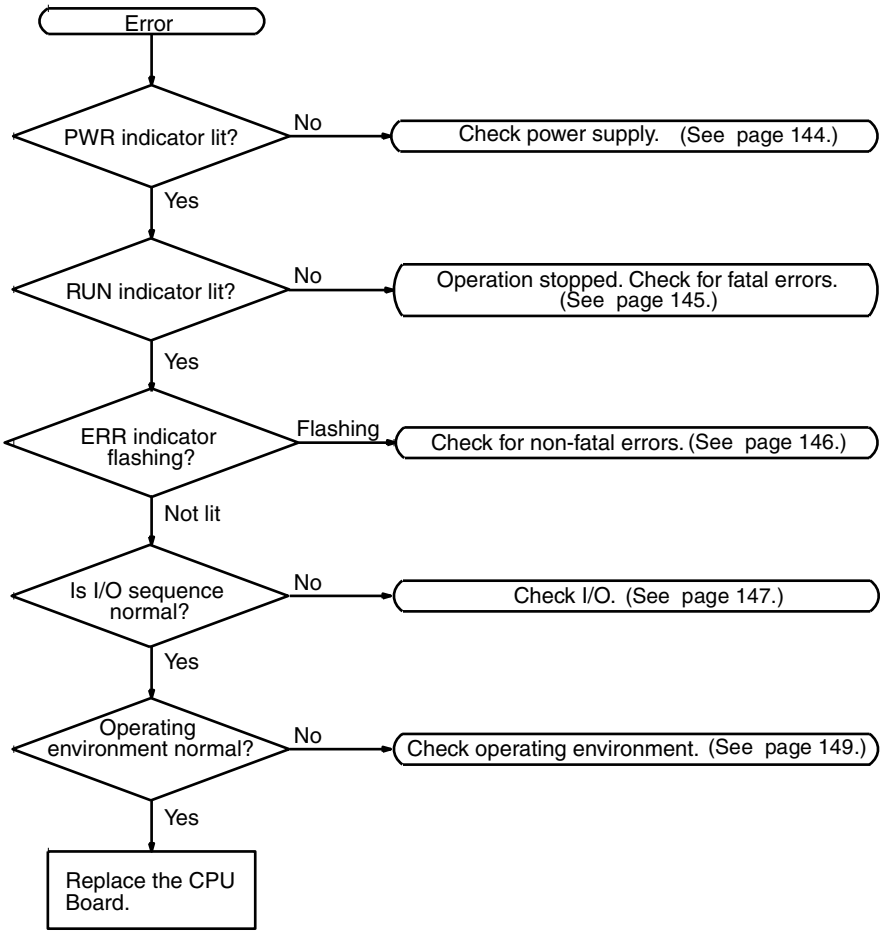
All CPU Board indicators will be OFF for the power interruption error. For all other fatal operating errors, the POWER and ERR indicators will be lit. The RUN indicator will be OFF.

Message	FALS No.	Meaning and appropriate response
Power interruption (no message)	00	Power has been interrupted for more than 2 ms. Check power supply voltage and power lines. Try to power-up again.
MEMORY ERR	F1	AR 1308 ON: There is a non-existent bit or word address in the user program. Check the program and correct errors.
		AR 1309 ON: An error has occurred in flash memory. Replace the CPU Board.
		AR 1310 ON: A checksum error has occurred in read-only DM (DM 6144 to DM 6599). Check and correct the settings in the read-only DM area.
		AR 1311 ON: A checksum error has occurred in the PC Setup. Initialize the PC Setup and input the settings again.
		AR 1312 ON: A checksum error has occurred in the program. Check the program and correct any errors detected.
		AR 1313 ON: A checksum error has occurred in the expansion instructions data and all function codes have been set the their default values. Reset the expansion instructions.
		AR 1314 ON: Data was not maintained in an area specified for holding. Clear the error, check the data in the areas specified for holding, and try again.
NO END INST	F0	END(01) is not written in the program. Write END(01) at the end of the program.
I/O BUS ERR	C0	An error has occurred during data transfer between the CPU Board and an Expansion I/O Board. Check the Board's connecting cable.
I/O UNIT OVER	E1	Too many Expansion I/O Boards have been connected. Check the Board configuration.
SYS FAIL FALS** (** is 01 to 99 or 9F.)	01 to 99	A FALS(07) instruction has been executed in the program. Check the FALS number to determine the conditions that caused execution, correct the cause, and clear the error.
1.	9F	The cycle time has exceeded the Maximum (Watch) Cycle Time setting (DM 6618). Check the cycle time and adjust the Maximum Cycle Time setting if necessary.

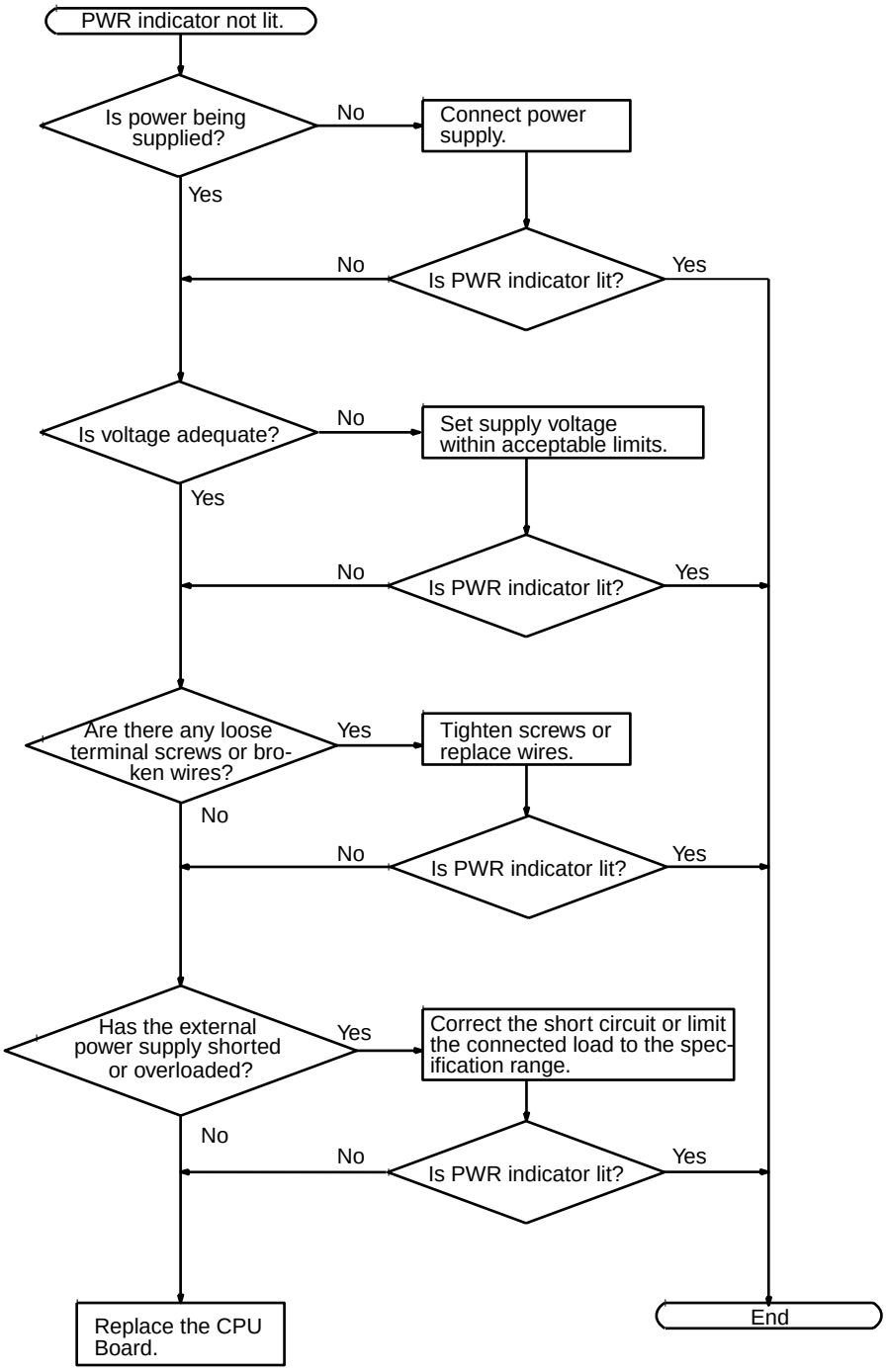
9-4 Troubleshooting Flowcharts

Use the following flowcharts to troubleshoot errors that occur during operation.

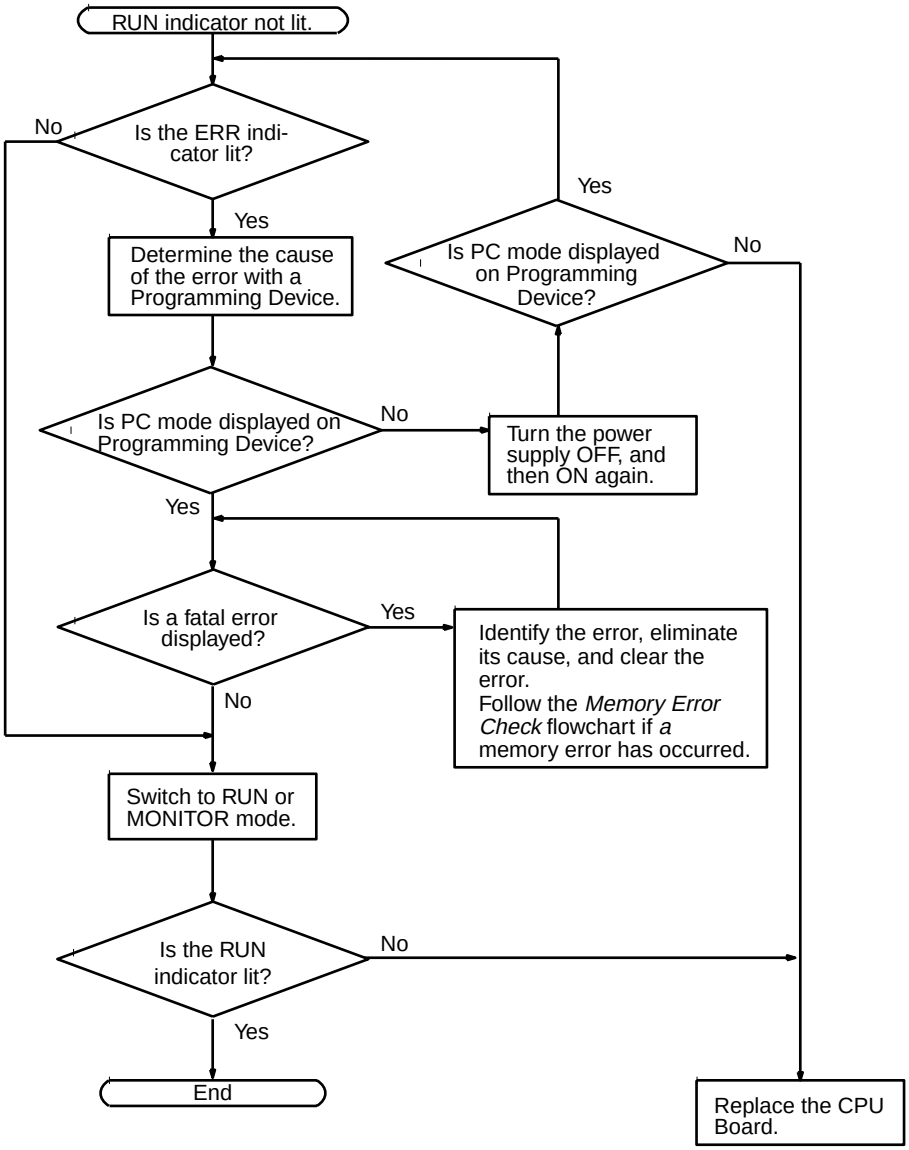
Main Check



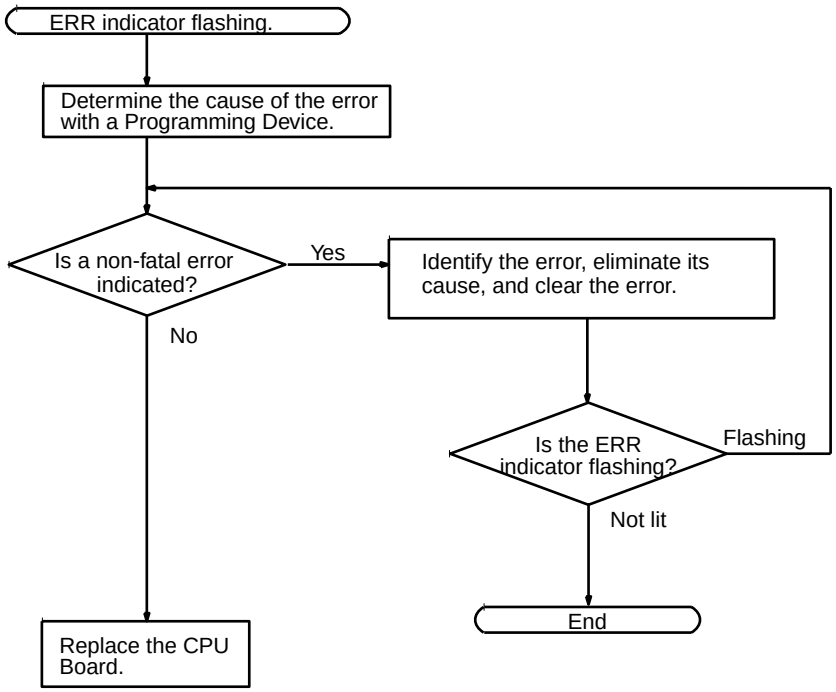
Power Supply Check



Fatal Error Check

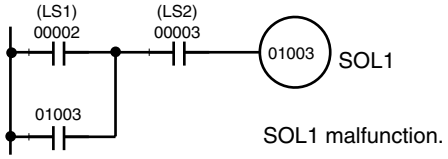

RUN indicator not lit.
Is the ERR indicator lit?
No
Yes
Determine the cause of the error with a Programming Device.
Is PC mode displayed on Programming Device?
No
Turn the power supply OFF, and then ON again.
Yes
Is a fatal error displayed?
Yes
Identify the error, eliminate its cause, and clear the error.
Follow the *Memory Error Check* flowchart if *a* memory error has occurred.
No
Switch to RUN or MONITOR mode.
Is the RUN indicator lit?
No
Yes
End
Is PC mode displayed on Programming Device?
Yes
No
Replace the CPU Board.

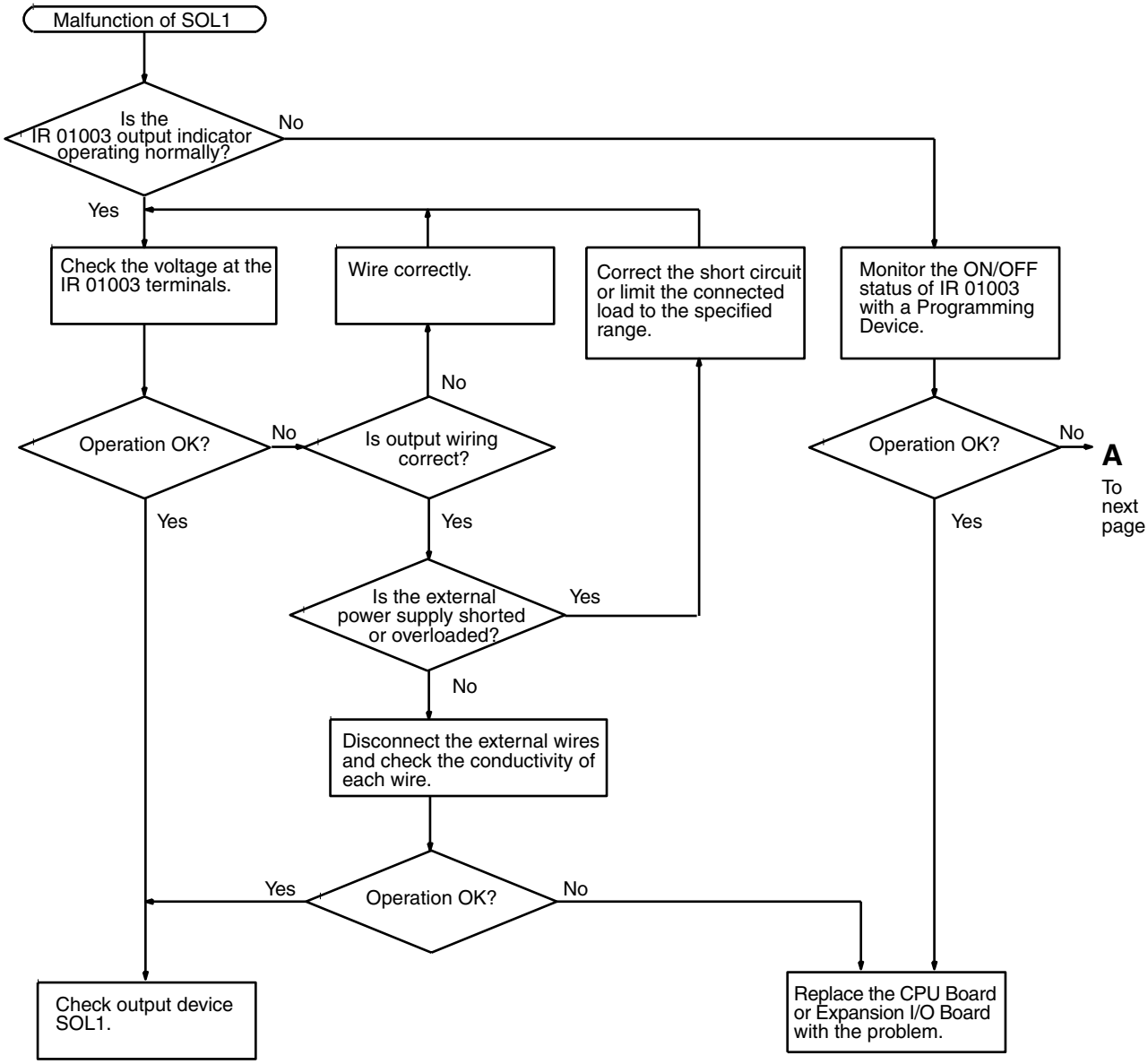
Non-fatal Error Check

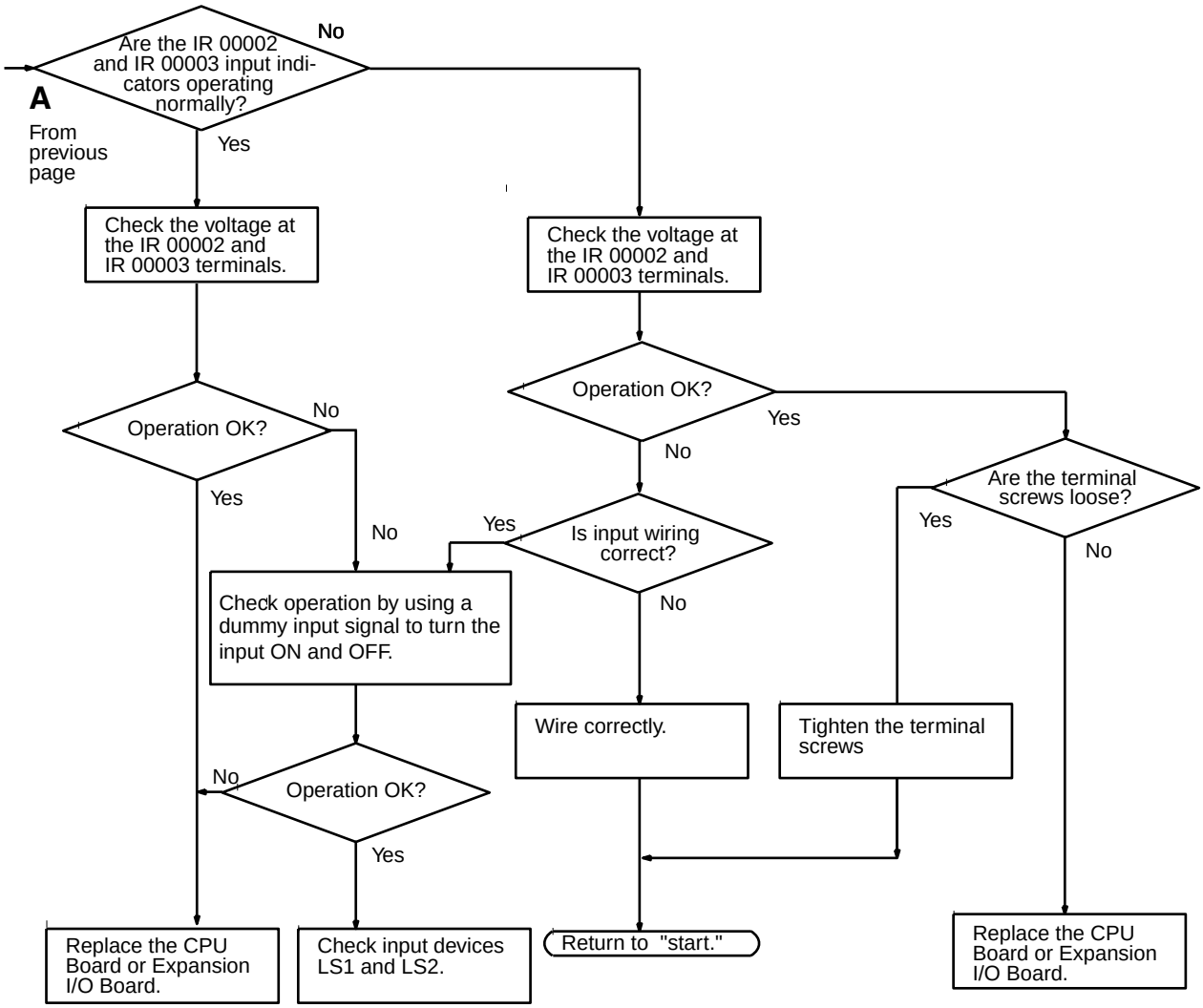


I/O Check

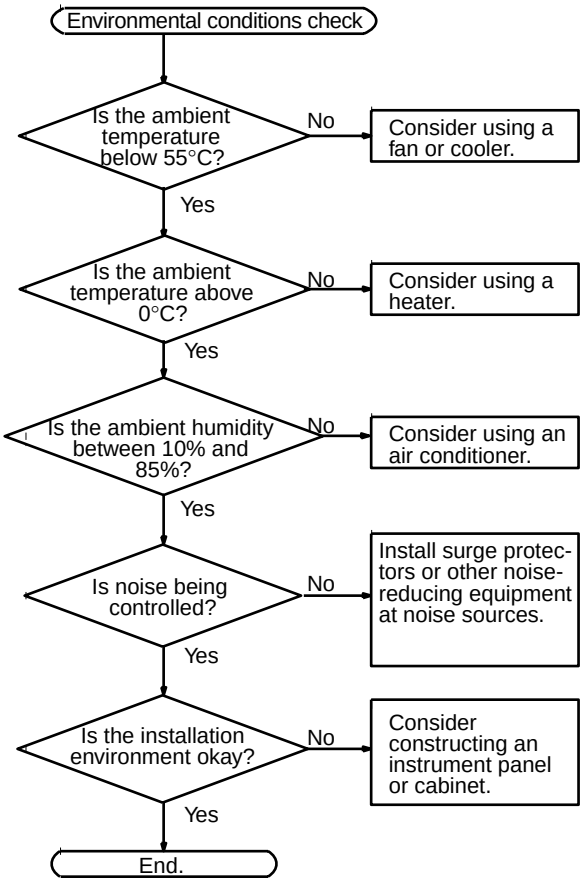
The I/O check flowchart is based on the following ladder diagram section.



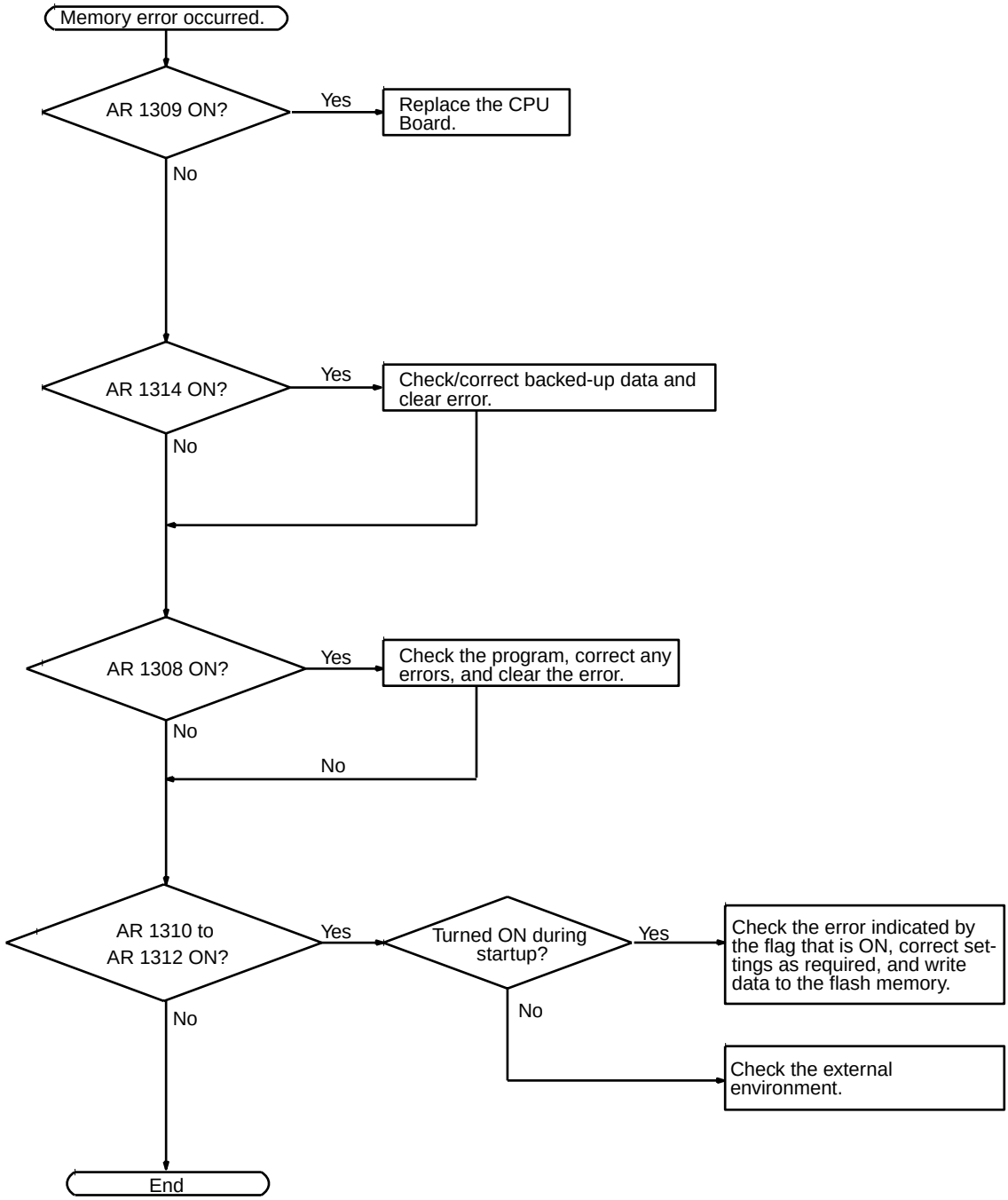



A
From previous page
Are the IR 00002 and IR 00003 input indicators operating normally?
No
Yes
Check the voltage at the IR 00002 and IR 00003 terminals.
Operation OK?
No
Yes
Check operation by using a dummy input signal to turn the input ON and OFF.
Operation OK?
No
Yes
Replace the CPU Board or Expansion I/O Board.
Check input devices LS1 and LS2.
Check the voltage at the IR 00002 and IR 00003 terminals.
Operation OK?
Yes
No
Is input wiring correct?
Yes
No
Wire correctly.
Return to "start."
Are the terminal screws loose?
Yes
No
Tighten the terminal screws
Replace the CPU Board or Expansion I/O Board.

Environmental Conditions Check



Memory Error Check



9-5 Maintenance Inspections

In order for your SYSMAC system to operate in optimum condition, be sure to carry out daily or periodical inspections.

Inspection Items

The main system components of a SYSMAC system are semiconductors, and it contains few components with limited lifetimes. Poor environmental conditions, however, can lead to deterioration of the electrical components, making regular maintenance necessary.

The standard period for maintenance checks is 6 months to 1 year, but more frequent checks are required if the PC is operated in more demanding conditions.

If the criteria are not met, adjust to within the specified ranges.

Inspection items	Details	Criteria	Remarks
Power supply	Determine whether the voltage fluctuation at the power supply terminals is within specifications.	Within the voltage variation range (20.4 to 26.4 VDC)	Tester
Environmental conditions	Is the ambient temperature inside the panel appropriate?	0 to 55°C	Thermometer
	Is the ambient humidity inside the panel appropriate?	35% to 85% RH with no condensation	Hygrometer
	Has dirt or dust collected?	None	Visual inspection
I/O power supply	Is the voltage fluctuation measured at the I/O terminals within the standard range?	Each I/O terminal must conform to the specifications	Tester
Installation status	Are all Boards securely installed?	Nothing is loose	Phillips screwdriver
	Are all connection cables and connectors inserted completely and locked?	Nothing is loose	Visual inspection
	Are any of the external wiring screws loose?	Nothing is loose	Phillips screwdriver
	Are any of the external wiring cables frayed?	No external abnormalities	Visual inspection
Product service life	Contact output relay	Electrical: Resistance load: 300,000 operations Inductive load: 100,000 operations Mechanical: 10,000,000 operations	---
	Battery (C500-BAT08)	5 years (at 25°C)	---

Required Tools

Standard Tools (Required)

- Screwdrivers (Phillips and flat-blade)
- Voltage tester or digital voltage meter
- Industrial alcohol and a cotton cloth

Measurement Devices (May be Needed)

- Synchroscope
- Cathode-ray oscilloscope
- Thermometer, hygrometer

Note Do not attempt to disassemble, repair, or modify the PC in any way.

9-6 Battery Replacement

⚠ **WARNING** Do not drop, disassemble, crush, short-circuit, recharge, or dispose of the battery in fire. The battery may explode, burn, or leak and cause personal injury.

Precautions

Turn ON the power supply for at least 5 minutes before replacing the battery in order to recharge the backup capacitor.

Turn OFF the power supply to the CPU Board before replacing the battery.

Use the procedure below when replacing the battery. This procedure must be completed within 5 minutes to prevent loss of memory contents.

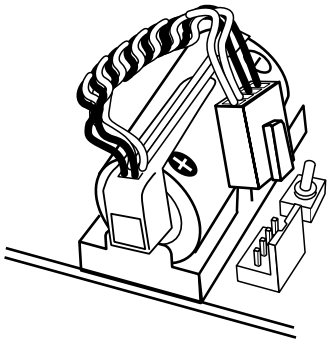
Dispose of the old battery properly.

Replacement Procedure

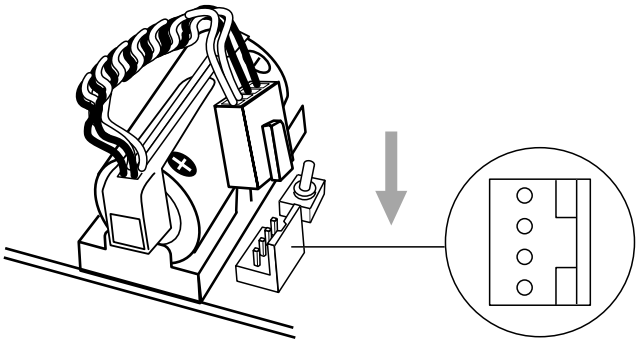
The life of the battery is 5 years at 25°C. Use the following procedure to replace the backup battery.

1,2,3...

1. Stop CPM2B-S operation and turn OFF the CPM2B-S's power supply.
2. Disconnect the battery connector and remove the battery.



3. Install the new battery. Check the alignment of the connector and fully insert the connector. Make sure that the power wires are not pinched.

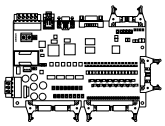


4. Enable the detection of battery errors in the PC Setup by setting the leftmost digit of DM 6655 to 0.

Appendix A

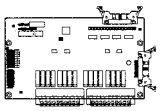
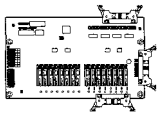
Standard Models

CPU Boards

Appearance	Transistor outputs (sinking)	Number of inputs	Number of outputs
	CPM2B-S001M-DRT	38 points	36 points

Accessories: Four 10 mm-studs, four M3 screws

Expansion I/O Boards

Appearance	Relay outputs	Transistor outputs (sinking)	Power supply	Number of inputs	Number of outputs
	CPM2B-32EDR	---	---	16 points	16 points
	---	CPM2B-32EDT	---	16 points	16 points

Accessories: Four 26-mm studs and four M3 screws.

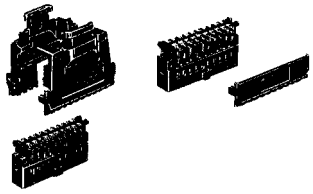
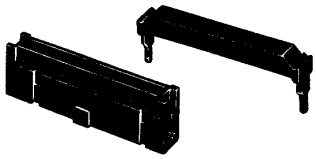
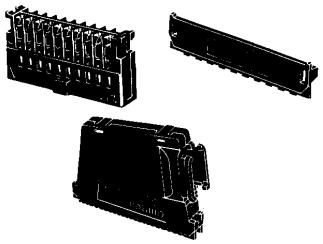
Expansion I/O Cable

Appearance	Model	Specifications
	CPM2B-CN601	Connects an Expansion I/O Board to the CPU Board or another Expansion I/O Board. (This cable is identical to the cable supplied with an Expansion I/O Board. Cable length: 60 mm.)

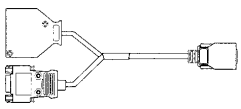
Mounting Bracket

Appearance	Model	Specifications
	CPM2B-ATT01	Includes four M3 × 4 mounting screws. **Note** The CPM2B-ATT01 Mounting Bracket is required when the system must meet UL/CSA standards.

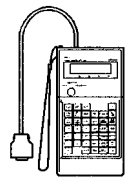
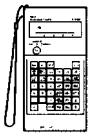
I/O Connectors

	Appearance	Name		Model
20P		Socket	AWG 24	XG5M-2032-N
			AWG 26 to 28	XG5M-2035-N
		Full Cover (2 required for each Socket)		XG5S-2012
		Partial Cover (2 required for each Socket)		XG5S-1001
		Socket		XG4M-2030
		Strain Relief		XG4T-2004
		Set (Socket + Strain Relief)		XG4M-2030-T
		Recommended Flat Cable		XG4T-200□
40P MIL		Flat Cable Pressure Connector		XG4M-4030-T
		Loose-wire Pressure Connector	Sockets	XG5M-4032-N (for 24 AWG wire) XG5M-4035-N (for 28 to 26 AWG wire)
			Partial Cover	XG5S-2001
			Full Cover	XG5S-4022

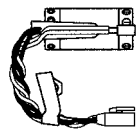
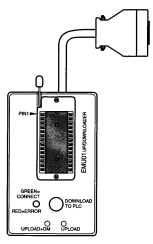
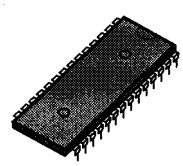
Communications Port Connecting Cables

Appearance	Name	Specifications	Length
	CS1W-CN114 Connecting Cable	Peripheral port to Programming Console cable.	0.05 m
	CPM2C-CN111 Connecting Cable	Peripheral port to Programming Console cable.	0.1 m

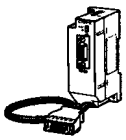
Peripheral Devices

Appearance	Model Number	Name	Specifications	
	CQM1H-PRO01-E	Programming Console	2-m Connecting Cable attached	
	CQM1-PRO01-E	Programming Console	2-m Connecting Cable attached Requires a CS1W-CN114 or CPM2C-CN111 Connecting Cable.	
	C200H-PRO27-E		Hand-held, w/backlight; requires a C200H-CN222 or C200H-CN422 Connecting Cable, see below.	
	C200H-CN222		Connects the C200H-PRO27-E.	2-m cable
	C200H-CN422			4-m cable
	CS1W-CN224		Connects the C200H-PRO27-E directly to a CPM2B-S CPU Board.	2-m cable
	CS1W-CN624			6-m cable
	WS02-CXPC1-E	CX-Programmer	For MS-Windows 95/98/NT (CD-ROM)	
	C500-ZL3AT1-E	SYSMAC Support Software	3.5”, 2HD for IBM PC/AT compatible	
	WS01-CPTB1-E	SYSMAC-CPT	For IBM PC/AT or compatible computers (3.5” disks (2HD) and CDROM)	

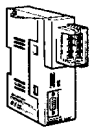
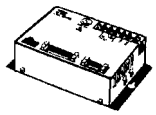
Maintenance Accessories

Appearance	Model Number	Name	Specifications
	C500-BAT08	Backup Battery	---
	CPM1-EMU01-V1	Expansion Memory Unit	Uploads the ladder program and DM 6144 to DM 6655 from the PC to the EEPROM and downloads the ladder program and DM 6144 to DM 6655 from the EEPROM to the PC.
	EEROM-JD	EEPROM	256 K bit

Adapters and Connecting Cables (1:1 Connection)

CPM2B-S port	Appearance	Model number	Name	Comments	Cable length
Peripheral		CQM1-CIF02	RS-232C Adapter	For a 9-pin computer serial port	3.3 m
		CPM1-CIF01		Use for peripheral port to RS-232C level conversion	
RS-232C		XW2Z-200S-V	RS-232C Cable	For a 9-pin computer serial port	2 m
		XW2Z-500S-V			5 m

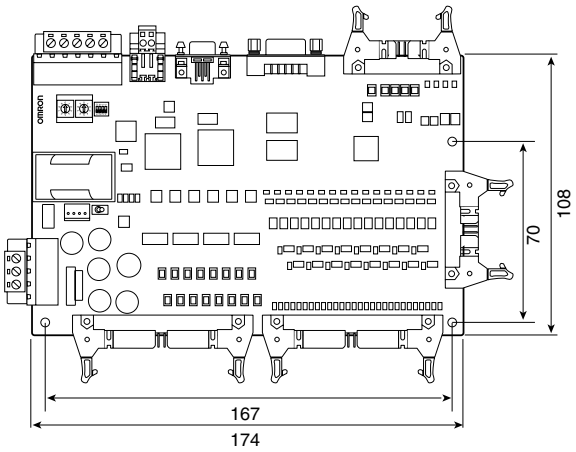
Adapters and Connecting Cables (1:N Connections)

Appearance	Model number	Name	Specifications
	NT-AL001-E	RS-422 Adapter	Use for CPM2B-S RS-232C port to RS-422A conversion. Requires a 5-VDC, 150 mA power supply which is supplied through the CPM2B-S connection. (Can also be connected to a personal computer, but this connection requires an external 5-VDC power supply.)
	3G2A9-AL004-E	Link Adapter	Use for personal computer RS-232C port to RS-422A. (Can also be connected to a CPM2B-S.)
	CPM1-CIF11	RS-422 Adapter	Use for CPM2B-S peripheral port to RS-422A conversion.
	XW2Z-070T-1	RS-232C Cables (For use with the NT-AL001-E.)	Use for CPM2B-S RS-232C port to NT-AL001-E connection. (0.7-m cable)
	XW2Z-200T-1		Use for CPM2B-S RS-232C port to NT-AL001-E connection. (2-m cable)

Appendix B
Dimensions

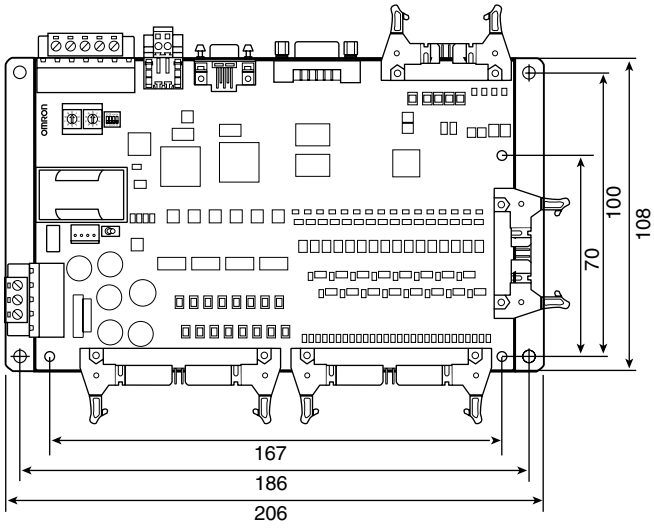
All dimensions are in millimeters.

CPU Boards and Expansion I/O Boards

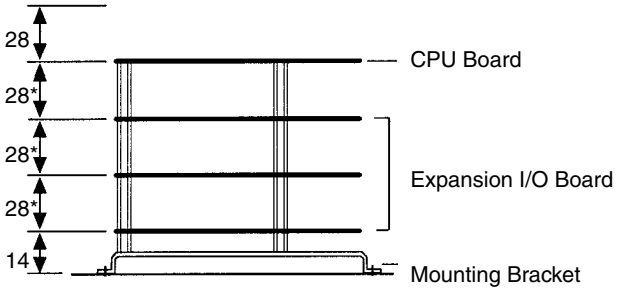


Assembly Dimensions

Front View



Side View



Index

Numerics

1:1 PC Link communications
  I/O response timing, 134
1:N connections, 11

A

Analog Terminals, 93
atmosphere, 22

B

battery
  replacing, 151

C

cabinet
  installation
    precautions, 35
cables
  available models, 154, 156
characteristics, 23
circuit configuration
  inputs, 25
communications capabilities
  overview, 5
Communications Errors, 139
communications mode
  CompoBus/S communications mode, 92
communications speed
  DeviceNet Communications, 98
communications status
  CompoBus/S, 95
CompoBus/S communications, 91
  communications mode, 92
  communications status, 95
  compatible Slaves, 93
  flags, 95
  I/O allocation, 94
CompoBus/S Communications Error, 139
CompoBus/S Master functions, 91
conduit installation, 40
CPU Boards
  available models, 153
  dimensions, 157
CPU Units
  cyclic operation, 17, 118
  internal structure, 14
CX-Programmer, 10
cycle monitor time
  PC Setup settings, 81
cycle time (minimum)
  PC Setup settings, 82
cyclic operation, 17, 118

D

data link, 6, 13
DeviceNet communications, 97
  examples, 108
  flags, 114
  LED indicators, 113
  status information, 113
dielectric strength, 22
dimensions, 157
duct installation, 39

E

electrical noise
  preventing, 36, 39
ERR indicator
  flashing, 141
  lit, 142
error log, 84
  PC Setup settings, 83
errors
  error processing, 137
  fatal, 142
  identifying, 139
  non-fatal, 141
  user-defined errors, 140
Expansion I/O Boards
  available models, 153
Expansion I/O Cable
  available models, 153
expansion instructions
  function codes, 90
explicit message communications, 101

F–H

FAL numbers, 141
FAL(06), 140
FALS numbers, 142
FALS(07), 140
false inputs, 48
fatal errors
  troubleshooting, 145
features, 2
flags
  CompoBus/S, 95
  DeviceNet, 114
  SR area flags, 66–68
flash memory
  precautions, 138
function codes
  expansion instructions, 90
functions, 7
hold bit status
  PC Setup settings, 80

I–L

I/O capacity, 23
I/O connectors
  available models, 154
  wiring, 41
I/O errors
  troubleshooting, 147

I/O line noise
  preventing, 39
I/O Modules, 93
I/O response time
  1:1 PC Link communications, 134
  See also timing
I/O Terminals, 93
indicators
  flashing ERR indicator, 141
  lit ERR indicator, 142
  PC status indicators, 28
inductive loads, 49–50
initialization
  time required, 16
input devices
  connecting, 46
input specifications, 25
input time constants
  PC Setup settings, 82
inputs
  wiring, 44
inrush current
  suppressing, 51
inspections, 151
installation
  site
    selecting, 35
instructions
  execution times, 121
  expansion, 90
  mnemonics list
    ladder, 87
insulation resistance, 22
interlocks, 34
interrupt processing
  calculating response time, 134
  masking, 133
  timing, 133
interrupt program execution
  in cyclic operation, 19
leakage current, 48
LED indicators, 28
limit switches
  preventing false inputs, 48

M

maintenance, 151
masking
  interrupt processes, 133
Max. number of CompoBus/S Slaves, 92
memory
  backup, 24
  protection, 24
memory areas
  AR area bits, 69
  flags and control bits, 66
  structure, 58
message communications, 101
modes
  operating modes, 15
motor control
  capabilities, 4
MSG(46), 141

N

node number
  DeviceNet communications, 98
noise
  preventing electrical noise, 36, 39
noise immunity, 22
non-fatal errors
  troubleshooting, 146
NPN current output
  connecting, 46
NPN open collector
  connecting, 46
NT Link
  connections, 12

O

operating conditions
  troubleshooting, 149
operating modes, 15
  operating mode at startup, 15
output short protection, 50
output specifications
  transistor output
    sink type, 26
Output Terminals, 93

P–R

panel installation
  precautions, 35
PC Setup settings, 73
PC status
  indicators, 28
Peripheral Devices, 155
  available models, 155
peripheral port
  servicing time, 81
Peripheral Port Error, 140
peripheral port servicing time
  PC Setup settings, 81
photoelectric switches
  preventing false inputs, 48
PNP current output
  connecting, 46
position control, 4
power
  consumption, 22
power cables, 39
power interruption
  detection, 16
power supply

precautions, 34
troubleshooting, 144, 150
wiring, 40
precautions
design precautions, 34
program capacity, 23
program execution
in cyclic operation, 18
program write protection
PC Setup settings, 80
programming
special features, 90
Programming Console
connections, 9
proximity switches
preventing false inputs, 48
pulse control, 4
pulse outputs, 4
wiring, 50
quick-response inputs, 4
relay outputs
connecting, 46
Relay Terminals, 93
connections, 42
remote I/O communications
through CompoBus/S, 93
through DeviceNet, 98
RS-232C port
servicing time, 81
RS-232C Port Error, 139
RS-232C port servicing time
PC Setup settings, 81

S

self-diagnosis functions, 24
self-diagnostic functions, 139
Sensor Amplifier Terminals, 93
Sensor Terminals, 93
settings
basic operations
hold bit status, 80
startup mode, 79
I/O operations, 79
port servicing scan time, 81–82
shock resistance, 22
Slaves
CompoBus/S compatible, 93
specifications
characteristics, 23
general specifications, 22
input specifications, 25
output specifications
transistor output, sink type, 26
SR area, 66–68
startup mode
PC Setup settings, 79
Support Software, 10
SYSMAC Support Software, 10
SYSMAC-CPT Support Software, 10
system
checks, 138
system configuration, 8

T

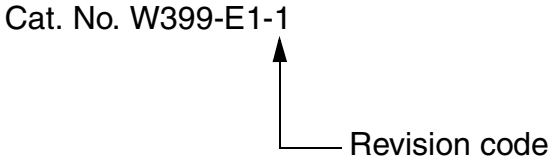
temperature
operating, storage, 22
temperature, ambient, 22
terminal blocks
connections, 42
test run
procedure, 138
timing
basic instructions, 121
I/O response time, 131
instruction execution
See also instruction
interrupt processing, 133
special instructions, 122, 129
troubleshooting, 143
fatal errors, 145
I/O errors, 147
non-fatal errors, 146
operating conditions, 149
power supply, 144, 150

U–W

vibration resistance, 22
voltage
supply voltage, 22
voltage output
connecting, 46
wiring, 39
I/O connectors, 41
power supply, 40
write protecting the program
PC Setup settings, 80

Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.



The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
1	May 2001	Original production

OMRON

OMRON ELECTRONICS LLC

1 Commerce Drive
Schaumburg, IL 60173 USA
800.55.OMRON (66766)

OMRON CANADA, INC.

885 Milner Avenue
Scarborough, Ontario M1B 5V8
416.286.6465

OMRON ON-LINE

Global - http://www.omron.com
USA - http://www.omron.com/oei
Canada - http://www.omron.com/oci

UNITED STATES

To locate a Regional Sales Office, local Distributor or to obtain product information, call:

800.55.OMRON or 847.843.7900

CANADA REGIONAL SALES OFFICES

Ontario	Toronto	416.286.6465
	Kitchener	519.896.1144
	Kingston	613.376.3968
Quebec	Montreal	514.636.6676
British Columbia	Vancouver	604.522.8855
Alberta	Edmonton	403.440.0818
	Calgary	403.257.3095

BRAZIL SALES OFFICE

Sao Paulo 55.11.5564.6488

ARGENTINA SALES OFFICE

Cono Sur 54.114.787.1129

MEXICO SALES OFFICE – UNITED STATES

Florida 954.227.2121

MEXICO SALES OFFICE – MEXICO

Mexico, D.F. 555.534.1195 **Monterrey, N.L.** 818.377.4281

W399-E1-1 06/02 Printed in U.S.A.
©2002 OMRON ELECTRONICS LLC Specifications subject to change without notice.